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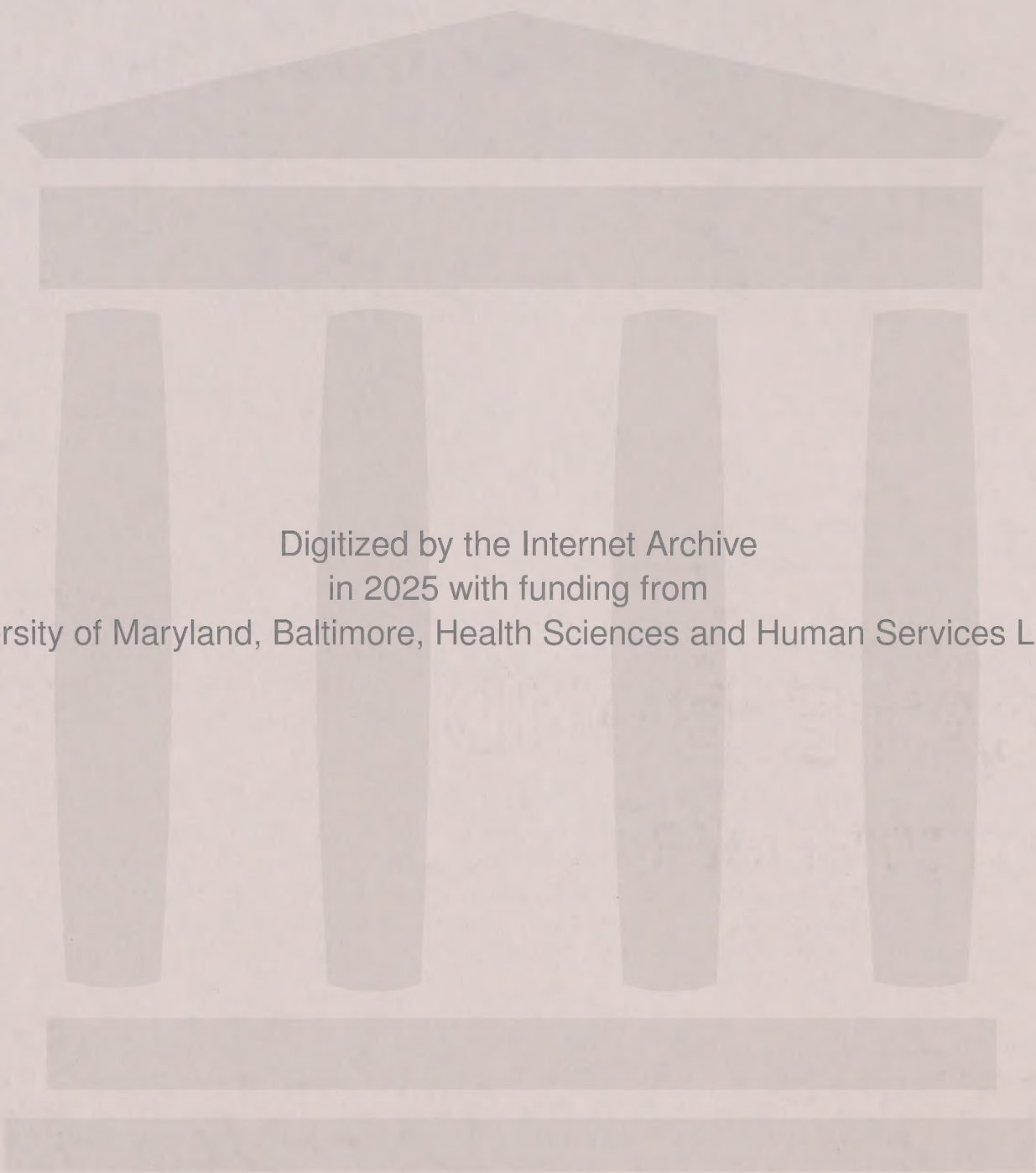
OFFICIAL JOURNAL

December 31, 1986

## AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

Gentlemen:

1. Report to the Board: Encl A is a copy of the Digital Committee report to the ARRL Board Meeting of January 16-17, 1987. This letter amplifies a few items mentioned in the report to the Board and covers a number of other items that have accumulated in my stack.
2. International Scene: The report to the Board is only the tip of the iceberg on this topic. Practically every foreign society is carrying packet articles (mostly rehash but indicating strong interest). Encl B is a policy paper on packet from the Wireless Institute of Australia. Encl C is a facsimile of RSGB's Connect International. Encl D is an assortment of papers to be introduced at the IARU Region 1 Division Conference, April 12-17, 1987. Encl E is an excerpt of the summary record of the IARU Administrative Council meeting in Buenos Aires, October 25-28, 1986. Encl F is a paper on "Packet Radio in Region 2" presented at the Region 2 Conference held in Buenos Aires, October 20-25, 1986.
3. SKIPNET: Each Committee member should have received my letter of December 11, 1986, which enclosed a draft of an Interim Operations Plan for Amateur Radio Ionospheric Packet Autoforwarding Net. If you haven't sent me comments, please do so by mail as soon as possible. The draft was sent with semicustomized cover letters to the HF stations involved with a requested reply date of January 15, 1987.
4. Region Packet Managers: On November 8-9, Field Services Manager Rick Palm and Public Service Manager Mike Riley attended the NTS Eastern Area Staff meeting in Williamsburg. They adopted a motion to appoint "Region Packet Managers" to promote the use of the mode for handling NTS-format messages. Several ARRL sections have appointed NTS packet liaison stations to ensure that NTS traffic is taken off of section packet BBSs. [Rick and Mike will be drafting Section 8 of the SKIPNET, which will deal with this topic. I expect to see lots of innovative choreography as old deals with new, or vice versa.]



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5. Sixth Networking Conference: It has taken a while to line up, but it looks like the 6th Conference will be held on Saturday, August 29, 1986 in conjunction with the TRW swap meet in the Los Angeles area. Per Phil Karn's suggestion, there is to be a tutorial for those who need it. The Digital Committee is to meet on Sunday. TRW ARC President Chris Wachs, WA2KDL will host; Harold Price, NK6K and Wally Linstruth, WA6JPR will co-chair. Before you go out and buy tickets and make any formal announcement, please be aware that, as a League-sponsored event, it requires Executive Committee or Board approval. Southwestern Division Director, Fried Heyn, WA6WZO, plans to move its approval at the January 16-17, 1987 Board Meeting.

6. 1987 Committee Meetings: In Encl A, I mentioned plans for two in-person meetings in 1987. I'll be polling you in separate correspondence concerning these meetings.

7. WWARA Digipeater Question Encl G is a copy of a letter I wrote to M. L. Gibson, W7JIE, in which I offered the opinion that a digipeater is not a repeater in the sense used in Part 97 of the FCC rules. Gib said that he had telephoned John Johnston and was told that a "digipeater is whatever you hams want it to be." Also John added that digipeaters were illegally identifying (such as "W7JIE-1") and should be sending "/R" instead. It's pretty clear that Johnston didn't remember that he wrote AX.25 into the rules and that it specifies how to identify (at least for handling third-party traffic). As for the WWARA proposal to pair up the 145.01... suite of frequencies with 145.61..., that's a different matter. I would appreciate your comments on the following questions:

a. Does duplex operation buy much in the 2-meter band?

b. Shouldn't they be pressing for 220- and 430-MHz duplex channels?

c. If pairs are needed at 2 m, should they use the 145.01 suite, which are practically national simplex packet channels?

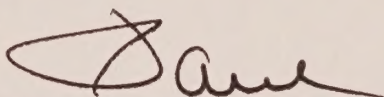
8. Packet Frequencies: While we have made progress on HF packet channels, our work on VHF and above is not complete. This is reflected in the questions raised by WWARA, above. At our June meeting we took a fairly laissez-faire attitude on what uses to assign to each VHF and above frequency. The feeling was that this sort of thing is best left to the coordinators and/or local packet groups. However, we still get inquiries from the very groups, such as WWARA, that we thought should make the local/regional decisions. It seems to me that we should give this matter some further thought and see if we can come up with a national model, some type of guidelines, or a tutorial piece exploring various options. It seems that some coordinators are slowly coming to the opinion that they should coordinate digipeaters or at least delegate some authority to a packet group. I would like to have this on the agenda of our next meeting.



9. Designators: I told Don Simon, NI6A, that I would distribute copies of his Dec 11 treatise on designators (Encl H) for your consideration.

10. Happy New Year: 1986 has been a great year for packet, particularly growth around the world. 1987 promises to be of the same magnitude. The users are getting restless -- they're looking to us to solve their problems.

73,



Paul L. Rinaldo, W4RI  
Chairman

Enclosures:

- A. Report to the Board
- B. WIA packet policy paper
- C. Premiere Connect International
- D. Papers for IARU RI Conference, Apr 87
- E. Excerpt of IARU AC Meeting, Oct 86
- F. "Packet Radio in Region 2," Oct 86
- G. Letter to W7JIE, Dec 22, 86
- H. NI6A letter, Dec 11, 1986



REPORT OF  
THE AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

1. International Scene

The number of packet terminal-node controllers (TNCs) now exceeds 20,000 worldwide; one estimate puts it as high as 30,000. The heretofore sleeping giant, Japan, has about 5000 in use. In addition to American imports, AIWA has recently begun manufacturing their own TNC. Shiro Nomura, JALCB, Kenwood Chief Engineer and Japan Amateur Radio Industry Association (JAIA) Technical Committee Chairman recently spent three days at ARRL HQ getting thoroughly briefed on packet technology and network development.

The British Department of Trade and Industry (DTI) (counterpart of the US FCC) authorized the RSGB to operate 14 experimental digipeaters beginning on November 22, 1986. RSGB also obtained an interpretation that amateur-to-amateur traffic is not third party. The question is how to untangle our more-liberal third-party rules to permit US amateurs to communicate with the stricter UK, which sees no problem.

In October and November, 1986, the Wireless Institute of Australia produced a detailed study of band plans, repeaters and packet radio.

A number of packet issues were discussed at the IARU Region 2 Conference and IARU Administrative Council meeting on October 20-25, 1986, in Buenos Aires. Resolution 86-2 urged to continue developmental work, confine packet operations to RTTY bands, restrict out-of-RTTY band operation to 1 frequency per band, address packet issues through regional organizations, and continue work on Resolution 85-7. An ARRL paper was presented on the subject: "Packet Radio in Region 2."

The Region 1 Division Conference, called for April 12-17, 1986, will take up various packet standards and frequency documents introduced by Finland, Norway and the UK.

The Digital Committee, International Affairs Vice President Olson and Executive Vice President Sumner are maintaining liaison with other IARU member-societies to keep track of fast-growing international developments in packet radio.



## 2. VHF Packet Development in the United States

The growth in TNCs has brought with it a greater number of digipeaters. The entire west coast is now linked, and the east coast almost so. Digipeater links spread across the US, and we are nearing the first coast-to-coast linking. Even if the links existed, their (1200-baud) speed is so slow and the reliability in places so low as to make it unfeasible to use VHF packet relays for transcontinental traffic. Higher speeds and improvement of radio links are now needed.

## 3. Higher Speeds for VHF/UHF

There are a few 9600-baud packet links in experimental operation, but reliable production equipment is needed. Several US manufacturers are working on this problem, as is the ARRL Lab. We took advantage of JALCB's visit to impress on him the importance of 9600-baud modems and especially the radios for 220 MHz and above.

## 4. HF Network Development

At its June 14-15, 1986 meeting, the Ad Hoc Committee on Amateur Radio Digital Communication took up the question of packet-radio frequencies in response to Minute 45 of the 1986 Annual Meeting of the Board.

The study of HF channels could not be accomplished in the abstract without developing a plan for their use, otherwise the packet community would ignore the recommendations. Also, we needed to resolve frequency problems in order to draft the Executive Committee-authorized request for an STA for unattended automatic operation of a limited number of HF stations.

In July, 1986, a letter, a general outline of proposed HF packet network operation, and a questionnaire were sent to 50 active or interested HF packet stations. Forty stations completed the questionnaire and indicated their general support of the outline. Propagation predictions were ordered from the Institute for Telecommunication Sciences, Boulder, CO, and used to develop frequency tables. A more-complete draft plan for the network, dubbed "SKIPNET" was sent to the respondents in December, 1986, with courtesy copies to Directors and certain Section Managers. We are now awaiting comments on the draft.

The SKIPNET plan proposes the establishment of 10 "teleports" in the continental United States to serve as major relay hubs. Each teleport is to consist of a cluster of nearby stations within VHF communications range of each other. Although initially for HF relay, teleports would eventually provide satellite and meteor-scatter service. This concept is in concert with the final report of the Blue Ribbon Committee on Emergency Message Traffic.



## 5. Packet Frequency Recommendations

In response to Minute 45 of the 1986 Annual Meeting of the Board, interim recommendations on some bands were forwarded to the Membership Services Committee and to the Board at the 1986 Second Meeting in the Digital Committee report. Study continued on others.

The SKIPNET draft nominates some HF packet frequencies for message forwarding. The Digital Committee awaits comments from the stations involved and some trial use including under the proposed STA.

VHF/UHF/SHF frequencies require further study and liaison with regional frequency coordinators. This will be undertaken by the Digital Committee in 1987.

## 6. Networking Protocol Development

Field trials of competing virtual-circuit and datagram networking protocols are underway in several parts of the country.

## 7. Sixth Computer Networking Conference

The Digital Committee recommended the Southwest as the site of the Sixth Computer Networking Conference. Director Heyn has firmed up arrangements for the conference to be hosted by the TRW ARC in the Los Angeles area on August 29, 1987. Digital Committee members Harold Price, NK6K, and Wally Linstruth, WA6JPR, have been named as coordinators. A call for papers will be issued immediately after Board approval of the conference.

## 8. Committee Meetings

Two in-person meetings of the Digital Committee are planned for 1987, one in March or April at ARRL HQ and the other on August 30 in Los Angeles.

Respectfully submitted,



Paul L. Rinaldo, W4RI  
Chairman



REVIEW OF AMATEUR RADIO SERVICE

PACKET COMMUNICATIONS

Policy Paper

from the

Wireless Institute of Australia

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Prepared by:

Federal Technical Advisory Committee.

Issue 3.1, 20th October 1986.

Note:

Sections 1 to 7 of this paper were originally written and circulated as Issue 2.1 prior to the 1986 Federal Convention. Some amendments were made at the Convention and these were incorporated in Issue 3.0. Following discussions with the DoC, advice was received on the approval for Packet Radio operation. This has been incorporated in Sections 8 and 9.



## 1. BACKGROUND

Packet Communications is a recent addition to the many varied modes of Amateur Radio communication techniques. It is still very much in the experimental stage, with developmental work continuing in many places, particularly the United States of America and Canada.

Packet Radio got its start in Vancouver, Canada, in 1979 with the development of a controller and modem by the Vancouver Amateur Digital Communications Group (VADCG). This design soon spread throughout both Canada and the United States.

With the personal computing revolution and the launching of elliptic orbit amateur satellites, high speed data communications around the world via radio became practical. This became the impetus for further development.

A major packet radio research and development organization soon evolved in the USA, known as the Tuscon Amateur Packet Radio Corporation (TAPR). This group developed its own hardware and software, and has close links with the amateur satellite organization, AMSAT.

The American group, backed by AMSAT, held several meetings in 1982 which culminated in the agreement to a new communications protocol more suitable to satellite activities. This protocol was accepted by the ARRL in March 1983 as the preferred protocol. The original Vancouver Protocol was modified in 1984 to overcome some of the limitations of the initial version.

Thus packet radio is still very much an evolving aspect of the amateur radio service. This is in line with the aim of the amateur radio service to be a "self-training, intercommunication and technical investigation" service. To enable the continued development of this (and other) aspects of the service, minimal restrictive regulations need to be imposed. The activities should generally be able to be carried on within the framework of the existing regulations.

This paper looks at the nature of packet radio and its need for regulation, and makes recommendations to the Wireless Institute for consideration, and if accepted, for forwarding to the Department of Communications.

## 2. DESCRIPTION AND USES

Packet Communications is a means of transferring information from one computer to another in an essentially error free form, with a defined protocol. The protocol includes the exchange of positive and negative acknowledgements. The data to be transferred, for example a line of text in ASCII, is bundled up into a "packet", along with an address and error checking information. This information is then transmitted via radio to another station.

If this information is received correctly at the receiving station, then a short acknowledgement packet is transmitted to the sending station. This allows the next data packet to be forwarded to the receiver. If a packet is received incorrectly, then the sending station is advised, and the original packet is re-transmitted.



The address field usually contains information relating to the identity of the sending and receiving stations. This can either be the complete call signs of the stations involved, or a standard interpretation of the call signs.

The equipment used includes the following:

- . A transceiver to transmit and receive the messages on the HF, VHF or UHF bands,
- . A Terminal Node Controller (TNC) which controls the communication system,
- . An input / output device, which can be a simple keyboard / screen device or a personal computer, and
- . A modem to convert the signals from the TNC into a form that can be handled by the radio equipment.

In addition to the above hardware, software to control the TNC and to enable the input / output device to communicate with it is also required.

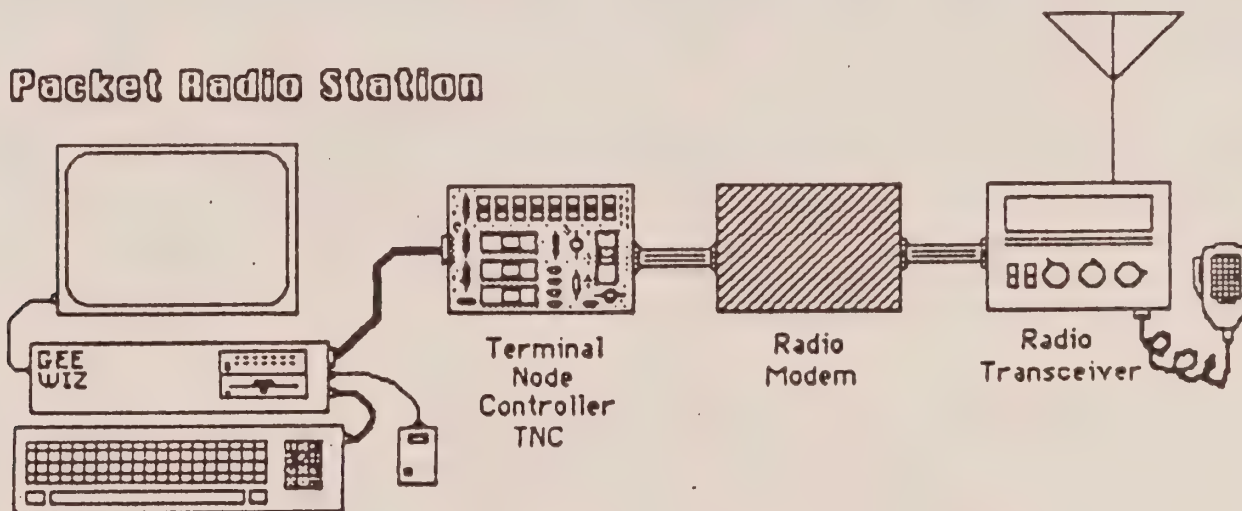


Fig 1. The configuration of a typical Packet Radio Station.

The uses to which packet radio are put are limited only by the capabilities of the radio and computer installations at each end of the link. The following examples indicate some of the potentially wide range of uses.

- . Point to point written communication. Although this is similar to RTTY, it is enhanced by virtue of the "store and retrieve" capability. Thus the recipient does not need to be reading the incoming message as it arrives, as the system will automatically "store" it. The message can then be "retrieved" at a convenient time.
- . Distribution of "text" files such as newsletters, articles etc. These can be prepared "off-line" using a word processor package, and then distributed "on-air" as appropriate.



- . Transfer of computer programs. By providing an essentially error free communications mechanism, large programs in both source code and binary formats can be transferred easily and reliably.
- . Emergency communication capabilities could be enhanced by the use of packet radio techniques. This would be especially so where lists of names and addresses and other similar information had to be transferred efficiently and accurately.
- . Digital transmission stream for coded analogue information, for example voice, slow scan television pictures, and facsimile etc.
- . Bulletin boards, for the distribution or exchange of information, new techniques etc.
- . Shared use of "network" resources, such as high quality printers, extra computing power etc.
- . Remote monitoring and control of unattended facilities such as a voice repeater.

Although the application of packet radio communication is mainly local at the moment, it is spreading overseas as more stations become involved in the techniques. Overseas contacts have been made via satellites and via direct HF contacts.

Contact with another station is initiated by instructing the TNC to make a call to the required station. The TNC monitors the chosen frequency to ensure it is clear and then transmits a "call request packet". If the other station is available for traffic, then its TNC will respond with a positive acknowledgement. This occurs without any active involvement of the amateur at the receiving station, other than to have put all the necessary equipment into operation.

The calling TNC then advises the operator that connection has been established with the required station. The calling operator then initiates the information exchange (for example the transfer of a computer file) which is received and automatically logged by the receiving station. The two TNC's control the information exchange process, linked together by a "virtual circuit" and ignoring other traffic which may also be on the same frequency.

### 3. PROTOCOLS

#### 3.1 Introduction

The development of software and protocols used in amateur packet radio networks has been influenced by several factors.

- . Existing, proven commercial standards should be used wherever possible, making only those changes which are necessary to allow operation in a half-duplex shared channel radio environment.
- . The informal nature of amateur radio precluded against protocols requiring a central control site for access control and address assignment.



As indicated in the introduction, two separate protocols have been developed, the first one in Canada and the second one in the USA. Both protocols are based on standard High Level Datalink Control (HDLC) frames and are loosely modeled on the CCITT X.25 packet switching standards. The main differences occur in the address field formats and error recovery procedures.

The Canadian protocol is usually known as the Vancouver Protocol after its city of origin, while the US protocol is known as AX.25, after the CCITT packet switching protocol X.25, which it is claimed influenced its development.

Each packet transmitted contains various types of information. This information includes synchronizing, addressing and control information, as well as the actual "data" being exchanged.

Various different types of Terminal Node Controllers (TNCs) have also evolved. Some TNCs will handle only one protocol, while others have been designed to handle more than one. The balance between hardware and software also varies, making some TNCs easier to modify for new developments than others.

### 3.2 The Vancouver Protocol, V2

The original Vancouver Protocol follows the IBM Synchronous Data Link Control (SDLC) address format standard. Whilst minimizing the data bits in the address field, this arrangement soon reached its limitations when linking and repeater requirements were considered. An upgraded version, V2, was released in 1984 by the Vancouver group. It is this upgraded version that will be discussed in the following paragraphs.

The V2 protocol has the address fields configured in a fixed format within the packet, with the first two octets defining the destination node address and the second two octets defining the source address. Thus, each packet transmitted has two addresses which denote the direction of data flow. Higher level protocol addressing is implemented in the Information Field.

The first sub-field is a variable length field called the "Network Header". The first octet within this sub-field defines the length of the field and whether another header follows the Network Header. Fixing the datalink addresses to a standard format simplifies the real-time software required to process the frames.

Fig 2. General Format of V2 Frame



The Datalink Address Fields are generated as a 'hashed' call sign. That is, a calculation similar to the Frame Check Sequence is performed on the user's call sign to create a unique node address. The sixteen bit fields define 65,535 binary addresses. As these addresses change dynamically from link to link, only enough addresses to cover a user's local area are required.

The numeric Datalink Address Field was selected to allow use of the "Selective Receive" function of the HDLC Protocol Controller chips. This function checks the first octet after the Synchronization Flag and processes the frame if a match is obtained. Otherwise, the frame is ignored. In this manner, the TNC CPU interrupt loading is significantly reduced, allowing very high speed operation.

The V2 Protocol follows the ISO Recommendations for Open Systems Interconnection Standards. It is a Level 2 Datalink protocol and does not contain higher level functions.

Station identification under V2 consists of an exchange of plain ASCII call-signs at the commencement of the QSO or "connection" in an information frame. Then, at approximately 75 second intervals (or other default value as set) during active operation, the node issues an information frame containing the plain ASCII call-signs of the two connected stations. At the end of the QSO, a sign-off call-sign exchange is again performed.

In the "unconnected" or "monitor" mode, the station is quiescent and does not transmit. If even one character is transmitted, the call-sign of the station will be issued at the next station ID default time. Thus, all transmissions are clearly identified.

This approach follows the accepted amateur station identification procedure and does not burden each frame with excessive redundant overhead. The high throughput of V2 is particularly evident when transferring files under marginal conditions which are often the case in amateur operation. Some timing comparisons have been done which indicate that V2 is approximately 20% faster than AX.25 when transferring files.

The V2 terminal nodes provide all the facilities for the assembly and disassembly of data into packets, buffer storage, and DTE control via a modified CCITT X.3/X.28 asynchronous terminal command structure.

Repeater or network nodes, on the other hand, are specialized devices that provide general services to the user community. The primary functions are data regeneration for range extension, network interconnect services, and local area test facilities such as remote memory dumps.

A repeater operates on a simplex store-and-forward basis where the repeater receives all packets and checks them for validity. If the destination station is logged onto the repeater, its packets will be flagged for re-transmission. The digital repeater then checks for a clear channel, retrieves the frame from memory and retransmits it. Using the network addressing, it is possible to forward these packets to another output port or to access a second repeater on the same channel, but in a different area.



The V2 repeaters are configured to accept AX.25 protocol frames, retransmitting them if they are correct. AX.25 traffic accessing the network through a V2 repeater is carried as an information frame at the network level.

### 3.3 AX.25

Although based on the CCITT X.25 protocol, there are some differences. For instance, X.25 is intended to operate on a full duplex link between data terminal equipment and packet switching exchanges. Modifications therefore had to be made to accommodate half duplex operation, and to allow the protocol to work between two pieces of data terminal equipment. Further, the address fields were modified to take full amateur call signs.

The call signs are used for source, destination and repeater selection addressing. Whilst very general in approach and following datagram principles, this protocol does have consequential disadvantages. The high packet overheads contribute to excessive re-try requests under marginal conditions, which is often the case with SSB contacts. It is also interesting to note that CCITT dropped the datagram methodology from X.25 in 1984.

The AX.25 protocol spread very rapidly throughout the USA when it was introduced due to the popularity of a repeater chaining scheme called "digipeating" (digital repeating). Digipeating is an addressing technique where repeater station call signs are inserted in the HDLC packet frame. The order in which the call signs appear indicates the routing of the frame and up to eight intermediate repeater stations can be accommodated. The main use of this capability is to extend the range of a station's normal coverage.

Intermediate link level error recovery procedures are not implemented in the digipeating process. Thus, if a packet is corrupted anywhere along the chain, the packet must be retransmit again from the originating station after the chain time-out period expires. It is clear that as the number of links increases, the system throughput rapidly decreases if there are any errors during transmission.

Experience in the USA indicates that the throughput of the channel drops to 90% with four digipeaters and to about 10% with seven digipeaters. A more detailed analysis of this problem appears in the TAPR PSR of July 1985.

Use of the current digipeating facilities requires a prior knowledge of available repeater stations. This has been overcome to a degree by the use of beacon messages periodically announcing the digipeating node's availability. In addition, TNC software is available to monitor and list such stations heard for digipeating access. The selection of a circuit then becomes an operator decision.

In spite of the difficulties experienced in using multiple digipeaters in network service, digipeating is still a very useful accessory as a range extension facility on one or two hop links. This may often be the only way a country station can reach a metropolitan local area repeater and inter-city data highway.



Whilst initially promoting all AX.25 TNCs to be equal members in a totally distributed network, it is now becoming increasingly clear that well-sited dedicated digital repeaters are required for AX.25 networks. The basic reasons are the same as those affecting normal voice facilities, that is the requirement for a prominent antenna site to give a wide area of coverage.

The development of higher level protocols for AX.25 has an added complexity due to the variable length address fields used for digipeating. A true level two protocol would not contain capability, as it would be incorporated at level three. This difficulty may be overcome by deleting the digipeating feature when in a network access mode, a proposition being contemplated in recent TAPR literature. Alternatively, a special version of AX.25 may be required at the network level. It is obvious that a large amount of development remains to be done and that there may be significant changes to the current standards.

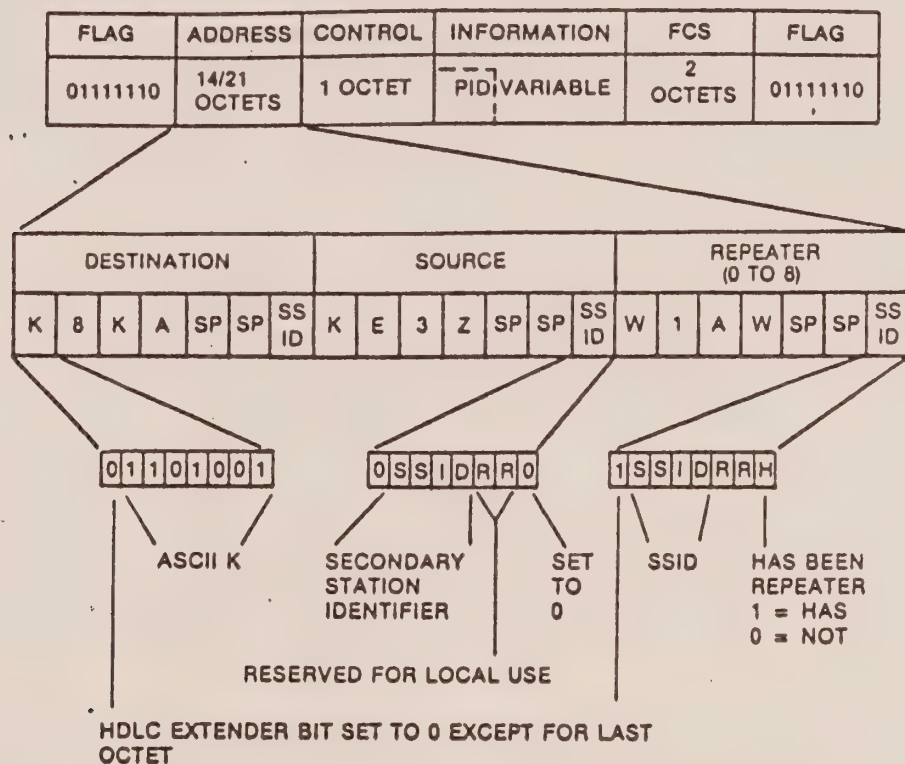


Fig 3. AX.25 Frame Format (ARRL Handbook)

The AX.25 frame carries a coded destination call-sign in the first seven octets following the HDLC synchronization bits, the source station call sign in the next seven octets, and the digipeating addresses in each of the successive groups of seven octets. This call-sign information is not plain ASCII, but is bit shifted one bit left to identify the end of each address sub-field. Thus, decoding identification information requires AX.25 software.



### 3.4 Conclusion

Both Vancouver and AX.25 protocols have been used in the amateur environment in Australia and overseas. Also, both protocols contain call sign information in each packet, AX.25 directly and Vancouver in a "modified" form. The requirement to identify amateur stations involved in communication should also be noted, and where the information is not available directly in each packet (as in the Vancouver protocol) it must be included in accordance with the DOC regulations on station identification.

It is considered that the WIA, and subsequently the DOC, should not "approve" of one protocol over the other, but rather encourage experimentation and flexibility. Further, any new protocols which may be developed should contain call sign information in some form in each packet.

### 4. UNATTENDED OPERATION

Repeaters and beacons are the most usual form of unattended operation encountered in the amateur service. However, packet radio by its very nature expands these requirements. In addition to the more obvious need for this capability in conjunction with a repeater, it also forms part of the operation of a normal packet radio station.

In order for the receiving stations TNC to confirm the reception of a packet of information, it is necessary for it to key the transmitter and send an appropriate acknowledgement packet. To ensure that the transmitter is not keyed on for an excessive time and thus "disable" the packet channel, it is necessary to incorporate fail safe watchdog timers. These are usually implemented in both hardware and software and disable the transmitter should it not reset within a specified time.

While voice repeaters are normally located on the highest site around, the experimental packet repeaters are currently located in home or club premises. This is necessary because of the care that the sophisticated computer systems require. Further, such computer systems are normally associated with other facilities such as information storage and retrieval systems.

The most common form of unattended information storage and retrieval systems is the "Computer Bulletin Board". These are common in the United States and becoming increasingly popular throughout the rest of the world. Currently there are a number of these in Australia connected to the telephone network.

The computer bulletin board is designed to simulate a cork pin-up board, typically located in a community or library facility. A person viewing such a board can look at the headings of various messages left by others under a number of subject headings. Selected messages can then be retrieved and read in detail, and new messages can be posted. However, a computer offers the ability to set varying degrees of access so that the privilege of posting a message can be given to only a few people. Reading the messages can also be selective - some messages being read by all users, others being read by entering a password. This allows the owner of the system to control and vet the way it is used.



The least privileged access, "Visitor Access", can be available to everyone, while an authorized user would need to be independently registered, supplying various details for this process, such as their name and address.

Other forms of information storage and retrieval systems allow the depositing and retrieving of computer programs. These are typically accessed via a directory. The programs found on these type of systems range from games to system utilities which have been developed by other users, or are available through public domain software sources. Exchange of copyright programs is not permitted under the copyright laws.

Other possibilities when using a remote computer system include the use of extra resources provided by that station. These could range from increased memory, access to a disk system, or the use of a letter quality printer. The necessary programs and data are forwarded to the remote computer, executed, and the output collected either via the communications link, or physically in the case of the hard copy output.

It is considered that all these uses should be permitted forms of operation for amateur packet radio stations. However, various classes of licence may be required to cater for these types of operation, depending on whether the station is operated in an attended or unattended continuous service mode.

## 5. RESPONSIBILITIES

The regulations that govern the amateur service have always allowed the amateur to develop and construct equipment to meet his needs. These regulations have prescribed the general technical requirements, but have not made any comment on the specific designs to be used. It is believed that this arrangement can be appropriately extended to packet radio.

Further, the regulations have always clearly laid down that the responsibility for the content of a transmission is always with the transmitting station. All transmissions (or groups of transmissions) are required to be identified by call signs and some form of log is often required.

Again, it is believed that this arrangement can be appropriately extended to packet radio. All packets transmitted contain call sign information, enabling the originator to be identified. Further, all remote use facilities, such as a bulletin boards can be logged, with all essential information recorded.

While it is likely that the operator of a computer system might review all the messages before allowing them to be posted to a bulletin board, this should not be essential providing the user is appropriately identified, and the incoming transmission logged. Thus the originator of any material which is not permitted to be exchanged via amateur radio can be clearly identified.



It is therefore proposed that there be no restriction of access (by password or any other mechanism) for devices that extend the range of amateur transmissions, such as repeaters. However, it should be necessary for the operator of a computer system with bulletin board or other store and retrieval system to log and identify all incoming messages on such a system.

Present repeater regulations permit a group or club to apply for a licence to operate such a device. It is considered that these regulations should also apply to any packet radio range extending device. Further, a group or club should be able to apply under similar regulations to operate a computer system offering any or all of the services described above.

However, no objection should be offered to any private individual who wishes to operate such a system provided that it is covered by an appropriate licence. Further, such computer systems should be able to have one or more levels of password access as determined by the operator to control access to its varied facilities.

As the number of packet radio stations increases, and as stations are established to provide repeating and computer access capabilities, it is likely that networks will be formed. Again, no objection should be offered to this providing all stations are appropriately licenced.

One mode of operation that becomes possible with the technology associated with packet radio is the automatic origination of calls. Thus a bulletin board system could attempt to automatically deliver an urgent message for a particular amateur, or a station could forward a message into a satellite bulletin board once it detected that the satellite was within range. It is considered that this type of operation is similar to the enhanced computer system operation described above and should be covered by the same type of licence.

It is noted that a number of computing systems already exist with connections to the telephone network. If such a system were to be connected to an amateur radio packet station, it could allow the general public to have access to the amateur radio service privileges without having completed any qualifying requirements.

Accordingly it is suggested that where any system is connected to both a telecommunication network and the amateur service, that material originated via the telecommunication network cannot be available for transmission over the amateur radio link.

As indicated in the Introduction, amateur radio is an experimental activity. This experimentation should be encouraged within broad guidelines. It is considered that the guidelines presented above, together with the history of self-regulation of the amateur service, will ensure that packet radio will be an appropriate way of continuing the philosophy of amateur radio.



## 6. BAND PLANNING

The transmission of packet information via a radio link is accomplished by modulating a radio frequency signal in a variety of ways. The band width of the transmitted signal depends, therefore, not only on the information signalling rate but also on the modulation technique.

Typical modulation techniques currently in use are frequency shift keying (FSK) and audio frequency shift keying (AFSK). The former is usually the result of using the tone output of the modem to modulate a single sideband transmitter, while the latter is the result of using the modem output to modulate a frequency modulated transmitter.

Depending on the baud rate and the shift, FSK can produce a narrow band signal and it is appropriate to transmit this type of signal on sections of the various bands designated for narrow band emissions. AFSK generally produces a wide band signal and this type of emission should be confined to the appropriately designated sections of the various bands.

Precise details of operating frequencies for packet radio activity will be included from time to time in the official WIA band plans.

## 7. RECOMMENDATIONS

After consideration of the various issues raised by the development of packet radio communication, the Federal Technical Advisory Committee presents the following recommendations for adoption by the Wireless Institute of Australia:

- 1) All packet radio protocols which ensure that call signs or call sign information is contained in each packet should be permitted, and that no requirements be placed on equipment design except those generally necessary under the existing amateur radio service regulations.
- 2) Any amateur radio operator may set up a packet radio station if permitted to do so under the terms of his existing licence. Further, such an amateur station may operate in the unattended mode for the purpose of receiving information from another packet mode station providing that suitable fail-safe firmware is incorporated to ensure that the transmitter cannot remain keyed on for an excessive period of time. While this station is operated in the attended mode, it may be used to receive and re-transmit incoming packets destined for other amateurs, and also provide computer or network resources.
- 3) Any group of amateurs may apply for a licence to establish and operate a continuously operating range extending or repeater device for packet radio. Such an application should be in the form of a conventional repeater application. No restriction should be placed on access to this facility by appropriately licenced amateur operators.



- 4) Any amateur or group of amateurs may apply for a licence to establish and operate a continuously operating station which provides computer resources for other amateurs. Such an application should be in the form of a conventional repeater licence. It should not be mandatory for restrictions to be placed on access to this facility by appropriately licenced amateur operators, this being up to the discretion of the licenced operator. All calls to this facility are to be logged by the system, the information to be recorded to include call sign information and time and date. Further, if such a system is connected to a telecommunications network, then material originated from such a network cannot be made available for transmission over the amateur radio link. Further, a system licenced under this section is permitted to automatically originate a call over the amateur radio service and deliver a previously lodged message.
- 5) That the above recommendations (1) to (5) be represented to the Department of Communications as guidelines for the operation of Amateur Service packet radio stations.
- 6) That protocols which comply with these guidelines and make efficient use of the radio spectrum be promoted.
- 7) That Terminal Node Controller designs which allow the use of more than one protocol be promoted.
- 8) That range extending repeater devices and computer systems that comply with recommendations (3) and (4) above be promoted.

If the above recommendations are accepted, both by the WIA and the DoC, then amateur radio operators will be able to continue exploring new frontiers of technology in the traditions established over the last seventy-five years.

#### 8. DOC APPROVAL

The above paper was presented to and debated at the 1986 Wireless Institute Federal Convention. The paper was accepted as policy and the recommendations approved. The Federal Executive was then requested to make the necessary representations to the Department of Communications. Subsequently, the DoC have advised in a letter to the WIA dated 30th September 1986 that "packet radio is permitted in the Amateur Service". Operation is, however, subject to the conditions detailed in an attachment which is reproduced below. These conditions will be included in the revised amateur handbook.

The following comments were also included in the letter:

"Additionally, noting the similarity between packet radio and RTTY, I would advise that the use of unattended operation and store/forward techniques employing RTTY is authorised. Stations utilising these modes of operation must, however, conform to the conditions outlined for packet radio in attachment A.



Recognising that version "V2" of the Vancouver packet protocol can not meet the identification requirements stipulated until an updated version is released, the Department is prepared to authorise use of "V2" until 31 March 1987. It is anticipated that version "V3" will be available by this time and it is understood that "V3" will fully comply with the identification requirements."

The letter was signed by David Hunt, Manager, Regulatory Operations Branch, Canberra.

#### 9. PACKET RADIO CONDITIONS

The following is a copy of "Attachment A" to the letter mentioned in the previous section.

##### GENERAL CONDITIONS

- (1) Novice Amateur Stations shall not use the packet radio transmission mode of operation.
- (2) Amateur stations utilising "packet radio" must conform to the general technical parameters and conditions applying to the Amateur Service.
- (3) Each "packet" shall contain the originating stations identification, that of the destination station and the station transmitting (if different from the originating station).
- (4) Amateur stations employing "packet" in an unattended operating configuration shall be fitted with;
  - (i) a timer to cause automatic shut-down of the station transmitter after 10 minutes of uninterrupted transmission.
  - (ii) a fail-safe facility to prevent the station transmitter operating due to equipment malfunction.
- (5) An amateur station shall not retransmit a "packet" signal in any amateur band that the originating station is not authorised to use.
- (6) Amateur stations when utilising the packet radio transmission mode shall not be connected to the switched telephone network.

##### IMPORTANT NOTES

- (A) Any protocol may be used for "packet" transmission provided it meets the identification requirements stipulated in (3) above.
- (B) The use of store/forward packet techniques by stations in the Amateur Service is permitted.



## Review of Packet Communications

- (C) Amateur licensees employing the packet radio mode of transmission are reminded that they are responsible for ensuring that third party traffic conditions are met. This point is especially important to note if using store/forward "packet" techniques on amateur bands below 30 MHz.
- (D) Providing the conditions stipulated in (4) above are met, amateur stations may operate in an unattended configuration when utilising the packet radio transmission mode.
- (E) Packet repeater stations must comply with the conditions applicable to repeater stations and those conditions outlined above.

(signed) D Hunt  
30/9/86

\* \* \* \* \*



# CONNECT INTERNATIONAL

Radio Society of Great Britain, Lambeth House, Carbourne  
Road, Potters Bar, Hertfordshire EN6 3JE  
Subscriptions/Change of address to: RSCB HQ

A monthly Amateur Radio publication for the packet radio  
enthusiast published by the Radio Society of Great Britain  
to the Editor - G3NRM, QTH: (Prestel Mail Box 21 9999/143)

D-Day - 22nd of November

Digipeating through the majority of the 14 experimental packet radio relay stations will be possible from noon on 22 November. A few days ago the DII announced that the operation of most of the packet relay stations could go ahead. Switch-on time will be 1200 GMT on Saturday 22 November 1986, an historic day for UK packet radio.

Remember that these stations are taking part in a limited life experiment which will terminate at the end of 1987. As a result of what is learnt further network plans can be made and a base-band chosen for a permanent UK packet radio network. During the experiment it should be possible to pass messages around certain parts of the system. Such messages can be passed either in real time or by means of store and forward facilities which will be available at some stations. Some groups will no doubt experiment with direct linking on a microwave band though permission for these links will, of course, be required.

One early experiment will be undertaken by G8JUP (University of Surrey). This group has obtained permission, via the Society, to use its satellite (UOSAT II) to pass packets to two gateway stations in the USA. The hardware and software for this experiment is in place, but there are some licensing aspects to finalise (Connect International will keep you posted).

At the time of writing (14 November) 10 relay stations had been given the go ahead to commence operation on 22 November. All stations will use fm on 144.650 MHz, with the exception of G8JVP, which will operate on 145.275 MHz. Those not yet cleared are annotated by an \* in the list given on this page. It is possible that some, or all, may be cleared in time to commence operation with the others. Finally, though digipeating and unattended operation are not yet permitted by individual stations, the Society hopes that these facilities will be agreed by the DII in the near future.

Call-Sign

QTH

Ant

G8JAP	Dudley, W.Mids.	V
G8JBP	Bristol, Avon	V
G8JDB	Honiton, Devon	V
G8JDP	Weymouth, Dorset	V
G8JCD*	Crewe, Cheshire	V
G8JEP	Exeter, Devon	V
G8JHP	Winchester, Hants	V
G8JHD	Potters Bar, Herts	H
G8JJP	St. Helier, Jersey	V
G8JKP*	Kingston-on-Thames	H
G8JNP	Norwich, Norfolk	V
G8JUP	Guildford, Surrey	H
G8JXP*	New Malden, Surrey	H
G8JVP*	Harrogate, N.Yorks	V

## THE MODEM-DISCONNECT SOCKETS IN THE TNC-1 AND TNC-2

From: Ed Harland, G3VPF  
9 October 1986

The TNCs that originate from the Tucson Amateur Packet Radio Corporation (i.e. the TNC-1 and TNC-2), and their derivatives such as the TNC-200 and PK-80, all include a "modem-disconnect" socket. This is a 20-way connector into which a number of links are normally plugged to connect the internal modem direct to the HDLC chip. If an external modem is used instead, the links are removed and the external modem cable inserted in their place.

In the TNC-1 the connector is a vertically mounted header in the centre of the board. In the TNC-2 and derivatives the connector is not normally fitted, but the board is pre-drilled to take a 20-way connector marked as J4, next to the Z80-SIO.

The links necessary for normal operation are part of the printed circuit board pattern and will need to be cut if the connector is fitted. These links are all on the underside of the board. For normal operation with the

internal modem after the connector has been fitted, links can be slid over the pins of the connector, as in the TNC-1.

The modem disconnect connector can be used to plug in an external modem to optimise performance on the HF bands, or for use with satellites (such as JAS-1) which need special forms of modulation.

Modem Disconnect Pin Connections

The functions of the pins on the two TNCs are as shown in the table below.

- Notes
- The TNC-1 clocks are both 32x the baud rate. The TNC-2 TX clock is 16x and the RX clock is at the required baud rate.
  - Pin 15 is ground on the TNC-2, whilst it is a clock selector on the TNC-1.
  - Pins 7 and 8 on the TNC-2 are status outputs and normally drive LEDs.
  - The use of pins 3 and 4 is different. In the TNC-1 they select the events which cause interrupts in the HDLC controller. In the TNC-2 they are used to select the special interrupt input to the SIO.
  - There is no ground pin on the TNC-1. Ground return must be a separate wire.

### MODEM DISCONNECT PIN CONNECTIONS

Pin	TNC-1	TNC-2
1	DCD i/p to HDLC	DCD i/p to SIO
2	DCD o/p from internal modem	DCD o/p from internal modem
3	Interrupt select 1	Special interrupt i/p
4	Interrupt select 2	Special interrupt source
5	Tx on/off from HDLC	RTS from SIO (Tx on/off)
6	PTT circuit input	PTT circuit input
7	DSR i/p to HDLC	Connect status o/p from SIO
8	DTR o/p from HDLC	DTR/PKts unacked status o/p
9	RTS o/p from HDLC	CTS o/p from SIO
10	CTS i/p to HDLC	connected to pin 6
11	TXCLK i/p to HDLC	TXCLK i/p to SIO
12	TXCLK source (32x)	TXCLK source (16x)
13	RXCLK i/p to HDLC	RXCLK i/p to SIO
14	RXCLK source (32x)	RXCLK from DPLL (1x)
15	Select 1x or 32x clk	Ground
16	Select NRZI to HDLC	No connection
17	RXD i/p to HDLC	RXD i/p to SIO
18	RXD from internal modem	RXD from internal modem
19	TXD o/p from HDLC	TXD o/p from SIO
20	TXD i/p to modem	TXD i/p to modem

Location of the first 16 UK AY-25 digital repeaters.

7P(2)

Enclosure C



## 9600 BPS FSK ON FM RIGS

From: David Wicks, G3YVD  
20 October 1986

The current AX.25 packet radio system on VHF uses 1200 bps AFSK FM. With the increasing popularity of packet radio, the single channel allocated for this activity on 2m has become congested during peak occupancy. The usual approach to congestion is to allocate another channel, but this policy suffers from two disadvantages: (1) no common channel would exist for all packet users - a fundamental advantage of the system, and (2) there is no spare capacity available from which to allocate another channel. Therefore an alternative technological solution is required which will need to make better use of the RF bandwidth available.

This in turn leads to the conclusion that the only alternative available is to increase the information carried per unit time; in other words, more bits per second.

There are two methods that could be utilised for increasing the data rate:

- (1) use improved modulation techniques to send data at higher speeds over the audio link provided by standard FM radios;
- (2) use a different RF modulation system, to make better use of the RF bandwidth available.

A major disadvantage of the first method is that complex modulation techniques would have to be used, in the form of multi-level PSK and amplitude keying. These techniques are used commercially, but the necessary modems cost thousands of pounds. The second method requires modifications to the radio, but an FM rig is ideally suited to a high speed FSK system as it already has the necessary circuitry for FSK transmit and FSK receive. It does mean that connections are required to the DC points of the circuitry, and the removal of the audio filtering, de-emphasis and pre-emphasis circuits from the signal path. This can be simply achieved.

### Standards

Before design can progress at the circuit level it is necessary to define the standard of the system to be implemented. Looking at the specification of the "typical" amateur FM receiver, the IF bandwidth is normally about 14-15 KHz. The filter, being designed for FM voice, will probably also have a low group delay distortion - important for data transmission.

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Using minimum shift keying (MSK), a bandwidth of 14 KHz will support a data rate of 9600 bps. MSK is a method of coherent FSK, with a shift of half the data bit rate. For a data rate of 9600 bps, the mark/space frequency shift is 4800 Hz, and the approximate bandwidth of the system is:  $4800 + 9600 = 14.4$  KHz.

### The Transmitter

To transmit high speed FSK signals it is necessary to convert the data output from the TNC to a suitable modulating signal for the frequency-modulated oscillator. This is the purpose of the circuit in Fig 1.

This circuit converts the output from the TNC into an adjustable voltage-stabilised signal with an adjustable DC offset. The purpose of generating this signal is to provide a stable FSK signal with 4.8 KHz deviation centered on the original FM channel.

The circuit does this by taking the output from the TNC into operational amplifier OP1, which is used as a comparator. The comparator voltage in the circuit has been set for TTL levels - if your TNC produces different signal levels then the comparison voltage will need to be adjusted appropriately; e.g. if it is RS232 then the comparison voltage would be zero.

The output of OP1 is clipped by the 4.7V zener diode (D3) and the series resistor (R2). The signal output from the zener is now stabilised as a swing from -0.7V to +4.7V, which ensures that the frequency shift is stabilised. Operational amplifier OP2 adds the variable signal from VR1 to the DC offset voltage from VR2, providing a low impedance drive signal to the varactor diode controlling the oscillator. Resistor R5 should be located near to the varactor to provide isolation between the varactor and the outside world. The output from OP2 must be connected via R5 to a point where there is a DC connection to the varactor, and this point must be after any low pass filtering and pre-emphasis circuitry used for voice modulation.

To set the frequency shift, first measure the frequency of the TX without the data circuitry connected, using a frequency counter or accurate receiver. Then connect the output of OP2 and adjust VR1 and VR2 for a mark/space shift of  $\pm 2.4$  KHz from the previously measured centre frequency. To force the mark and space, attach a 100K resistor to the data input of OP1 and connect it in turn to the +12V and -12V power rails.

### The Receiver

The receive side of the modem needs to take the output from the receiver's discriminator circuit, via a low pass filter and a comparator, to provide a data stream to the TNC. This function is carried out by the circuit of Fig 2.

First it is necessary to locate the audio output point of the discriminator, where it is DC-connected and before de-emphasis. Most modern receivers use an MC3357 IC or equivalent - if this is the case, pin 8 is the required point. Resistor R6 should be mounted close to the tap point to provide some isolation and protection.

This output is fed into a linear phase

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low pass filter to remove the IF and reduce the noise bandwidth. The output of this filter is then fed into a comparator (OP4), which compares it with an offset voltage, to compensate for the offset voltage from the discriminator. To set up the circuit, input a signal to the receiver at the centre frequency, and measure the output voltage from the low pass filter (at point A) with an analog meter. Then adjust VR3 to the same voltage. It should be noted that the discriminator needs to be aligned accurately; otherwise an R offset will be needed to receive the FSK signal correctly.

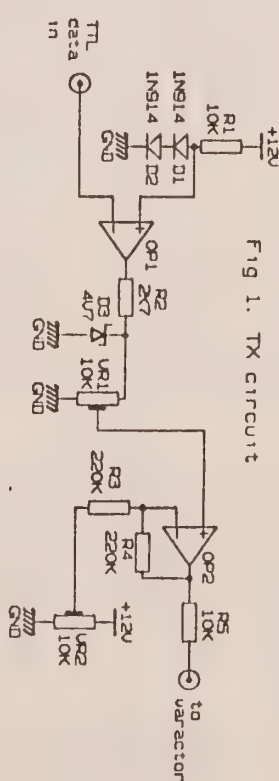


Fig 1. TX circuit

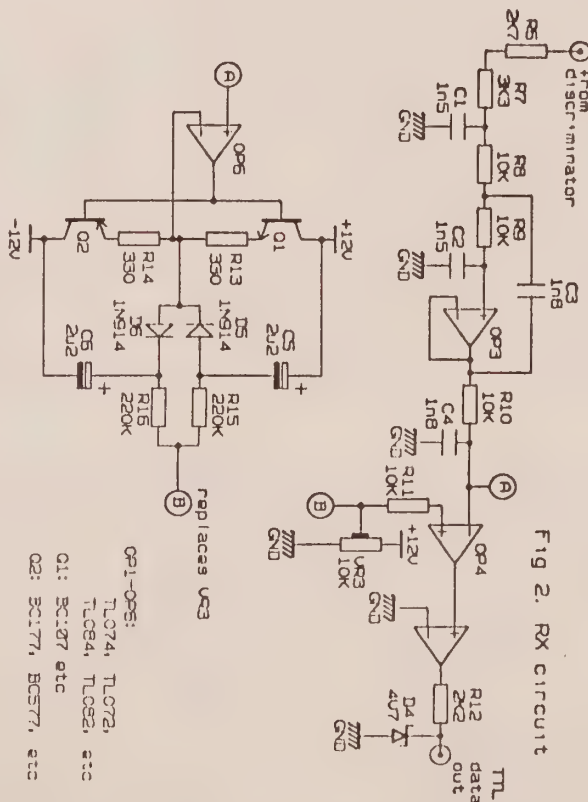


Fig 2. RX circuit

Fig 3. Automatic threshold circuit

DESIGN LAST MODIFIED: Nov 5 15:00:21 1986



# Automatic Setup of Comparator Voltage

Figure 3 is an experimental circuit for setting the comparison voltage automatically; this circuit has not yet been fully tested. It can also be used as a tuning aid by connecting point B to an analog meter. Adjust the tuning until the meter reading with packet burst present has the same value as the comparison voltage set by VR3.

## Performance

In testing the system with a locally generated FSK signal source, it was noted that, as would be expected, the system had an FM threshold effect. This threshold seemed to occur at approximately the same signal-to-noise ratio as that for the currently used 1200 bps AFSK FM system. A decided advantage of the MSK system is that the data rate is eight times higher, with similar bit error rates. If poor performance is obtained then a slight improvement could be gained by using the same frequency shift but reducing the speed to 4800 bps.

## NIBBLES

>>>> Ed Harland, G3VPF, has written a four-page introduction to packet radio explaining the principles of packet and the requirements of a packet station. There are also lists of TNCs and packet groups. A useful intro.

>>>> Reg Brake, G80R, reminds us that the Sunday morning packet net on 80m still takes place, around 3.600 MHz +/- 60m, starting at 1130 UTC. G5DS is a regular, and the odd DL and GM have also joined in. Reg is the coordinator for the Norwich digipeater and the site and station are ready to go. He also says he is up to 33 countries on packet, just three behind local rival G1DL.

>>>> Kris Partridge, G8AUU, compiler of the International VHF FM Guide, says he is considering including packet digipeaters in future editions. He plans to visit Poland early in the New Year, under his call SO6AUU, and will let us know if there are any packet stations active.

>>>> Roy Harcup, G4GGS, in Manchester is interested in carrying out packet tests on 10m FM at 1200 bps. He wants to know if anyone is already doing this, and what frequency is used.

>>>> Adrian Reddish, G6MGD, says that the Hatfield Data Group have produced an AX.25

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To maximise throughput using the AX.25 protocol it should be noted that the TX/RX switching delays will be the same, although the synchronisation time will be reduced. To exploit the system fully, the best strategy would be to send fully-filled I-frames, and to send multi I-frames on each transmission. This then reduces the percentage time that the channel is occupied by signals not sending data. Full I-frames and multi I-frames should especially be used by mailboxes and bulletin board systems.

To ensure that the packet system does not outrun the ability of the terminal to capture and display data, it is suggested that the serial data rate between the TNC and the display device be at least 9600 bps - I use 38200 bps for this link.

David is not QTHR. His address is: 6 Pine Grove, Bricket Wood, St Albans, Herts, AL2 3SSJ.

TNC which is compact, has low power consumption for portable use, a watchdog timer, and a modem disconnect point to allow alternative modems to be attached.

>>>> ON1AMB maintains a list of packet stations in Belgium (total of 112 stations at 4 November 1986). Many using the Commodore 64, plus several using the DL2MDL Apple system, IBM-PC MPN and KPC2 TNCs. Also one station using the KPC2400, and another with the PK232 TNC. There is a digipeater in Brussels (DN7RC) on 144.675 MHz.

>>>> In the instructions accompanying the new JAS-1 packet modem pcb, James Miller, G3RUH, points out that the modem can also be used for terrestrial packet experiments using PSK modulation on an ssb radio. He claims that PSK offers an improvement of at least 10dB compared to conventional AFSK FM.

>>>> The August 1986 issue of "73" magazine is a packet bonanza! Page after page of articles, including: a packet primer; operating packet; precision packet tuning (an all-digital TONI-Tuna, with a resolution of 10 Hz); how to run a packet BBS; packet and satellites; a connect alarm; how to put digipeaters on mountains; what comes after Level 2; packet questions and answers; and a packet TNC buying guide. The best set of introductory articles ever appearing in one place. A collector's item.

# A MULTI-STANDARD MODEM FOR THE TNC 2

From: Ed Harland, G3VPF  
9 October 1986

The modems built into the TNC-1 and TNC-2 (or TNC-200, PK-80 etc) use the Exar XR series devices to implement a single-standard Bell 202 modem using 1200 Hz and 2200 Hz tones. This works well at VHF, but for HF or satellite use the commonly used standard is 300 Hz shift. To use the internal modem in this mode one either has to remove the case in order to change the plug-in headers or else fit one of the simple mods using switched resistors and capacitors. Changing the headers is best, but very inconvenient, whilst the switch mods, although simple, do not perform as well.

An alternative is to fit a multi-standard modem which connects to the modem-disconnect socket on the TNC main board. This note describes such a unit which is capable of operating with all the current frequency shift keying (FSK) standards.

## The circuit

The unit (Fig 1) uses an AMD AH7910 single-chip modem which uses digital signal processing techniques to implement the transmit, receive and filter functions. The various tone standard and filter functions are selected by applying a 5-bit control code to pins 17-21 on the chip. The codes are inconvenient to generate directly from a switch (there are 32 possibilities) so an 82513 PROM is used to convert the combinations generated by the switch to those required by the AH7910. The switch can be anything from a simple toggle switch if only two sets of tones are required, up to a hex thumbwheel switch if the ultimate in flexibility is desired. It is also possible, via the VN10 and relay, to select local copy for test purposes. An alternative circuit using a single-pole c/o switch to select HF or VHF operation is shown in Fig 2. If this is used, the VN10 and relay for local copy are not used.

The output from the 7910 is about 700mV RMS, and this is attenuated to a level appropriate to the microphone input of most transceivers by the 50K/1K divider. On receive, the audio is fed in via the 1K/1K divider and two protection diodes. These diodes are used to protect the 7910 input from excessive input voltages and must be germanium or Schottky types with low forward voltage drop.

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The PIT output is driven by a VN10 device and must be used with the type change-over circuit found in most current transceivers in which a positive voltage pulled to ground on transmit. The VN10 switch currents of up to 400mA and therefore work with most transceivers. 74HC14 and associated components form a second resettable monostable which prevents the transmitter from staying on for longer than this period. This protects other characters from interference in the event of a fault in the TNC. The 74HC00 is used to select automatically the appropriate clock for the required baud rate.

The 82513 is a PROM for converting switch outputs into the 7910 control code. The required combinations are:

CODE	MODE	tx	tones
00000	Bell 103 Drig	1070/1270	2025/2
00001	Bell 103 Ans	2025/2225	1070/1
00010	Bell 202	2200/1200	2200/1
00011	Bell 202 equalised	2200/1200	2200/1
00100	V21 Drig	1180/ 980	1850/1
00101	V21 Answer	1850/1450	1180/
00110	V23 Mode 2	2100/1300	2100/1
00111	V23 Mode 2 equal'd	2100/1300	2100/1
01000	V23 Mode 1	1700/1300	1700/1
10000	Bell 103 Drig loop	1070/1270	1070/1
10001	Bell 103 Ans loop	2025/2225	2025/1
10010	Bell 202 loop	2200/1200	2200/1
10011	Bell 202 eq/loop	2200/1200	2200/1
10100	V21 Drig loop	1180/ 980	1180/
10101	V21 Ans loop	1850/1450	1850/1
10110	V23 Mode 2 loop	2100/1300	2100/1
10111	V23 Mode 2 eq/loop	2100/1300	2100/1
11000	V23 Mode 1 loop	1700/1300	1700/1
11001	V23 Superv. loop	450/ 390	450/

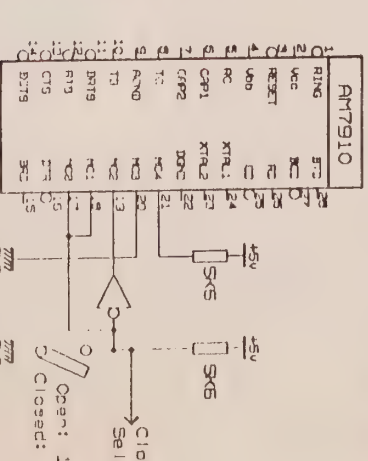
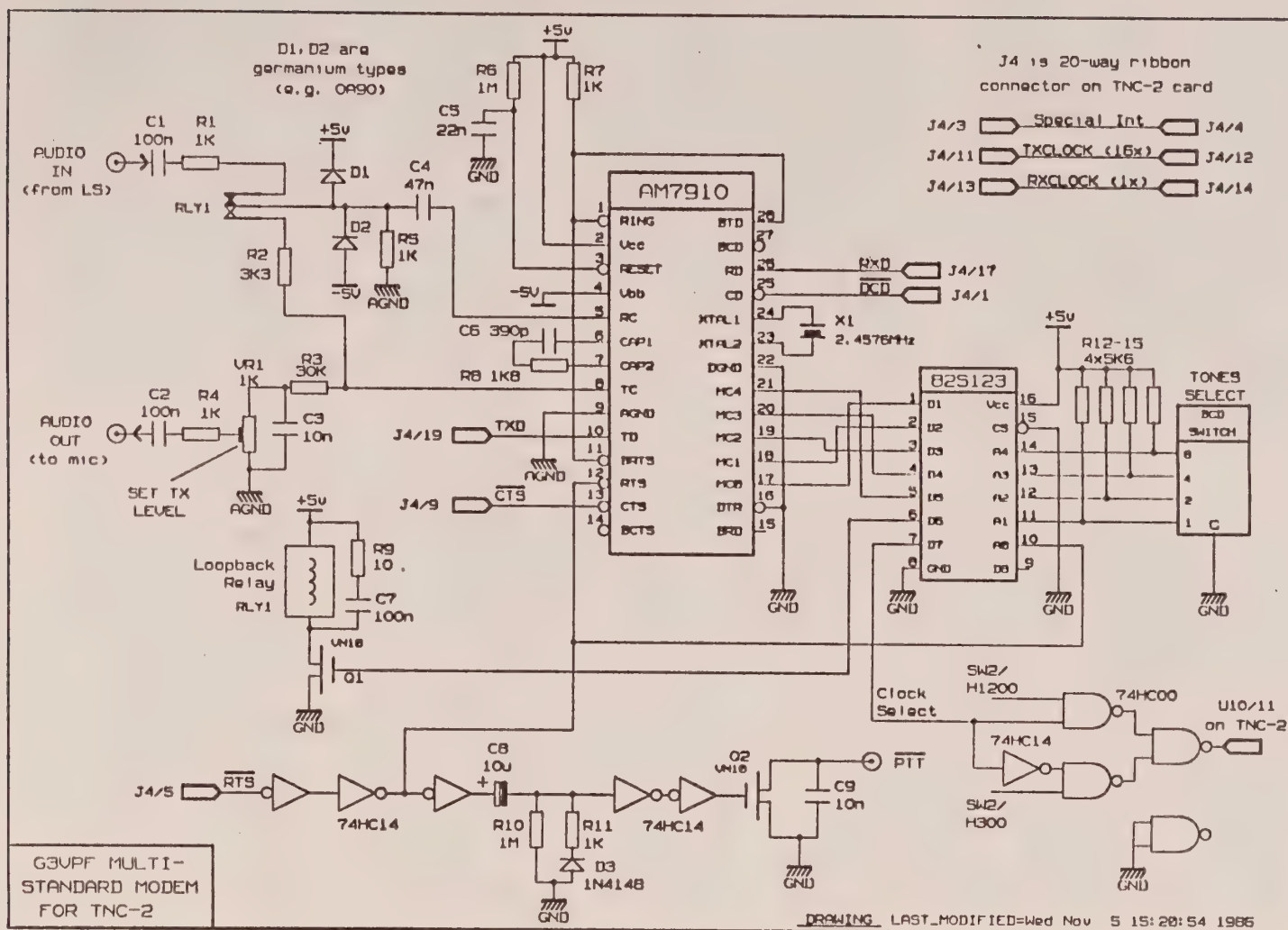


Fig 2. Simultaneous clock select circuit.





C1/Nov86/17

The possible shifts available are 1kHz, 600Hz, 400Hz, 200Hz, and 60Hz. The standard on VHF is 1kHz and on HF it is 200Hz. The other shifts are useful if like-equipped stations can be found when conditions are appropriate. When using the tone standards which are normally used with split frequencies on transmit and receive, the loopback mode must be selected. If only two sets of tones are required it is possible to replace the 2N5123 with static logic and use the Bell 202 equalised loopback mode (10011) for VHF and the CCITT V21 Griginate loopback mode (10100) for HF.

Experience has shown that the 1180/580Hz tones work best with most HF transceivers. Note that with NRZI encoding as used in AX.25 packet, space and mark have no meaning and tone reversal does not matter.

## THE RNR PROBLEM

From: Ed Harland, G3UPF  
19 August 1986

### The Scenario

Jim is monitoring the packet channel whilst working in the shack and has set MONITOR ON. He is then called away to answer the phone, eat a meal (or whatever), and hits control-S to hold any incoming information in the TNC until he gets back. Within a few minutes all available memory in the TNC is full, due to the monitored multiple retries from another station across town who is trying to work a weak station.

At this point, Bill tries to connect to Jim, the two TNCs complete the SSB/HV/UA handshake, and a connection is established. However, when Bill sends his first information packet, Jim's TNC responds with an RNR (Receive Not Ready) frame to tell Bill's TNC that he is unable to accept further information frames due to a lack of memory space.

After a short time, Bill's TNC sends an RR (Receive Ready) frame to interrogate Jim's TNC and test to see if it is ready to resume information transfer. Again, Jim's TNC responds with an RNR-frame.

This situation continues indefinitely, until either Jim returns and types control-Q to allow the memory to be dumped to the host, or Bill gets fed up and disconnects. Unfortunately, Bill sees no indication of a problem, and if he is not familiar with the AX.25 protocol he may take some time to realise that something is amiss. The only indication of a problem is a lot of

transmitter activity. In the meantime, the channel is cluttered up with many RR/RNR exchanges which can occur as often as every two to three seconds.

### The reasons

The AX.25 specification refers to the use of RNR in several places:

- para 2.3.4.2.2 RNR command and response;
- para 2.3.5.1 DXE busy condition;
- para 2.4.4.2.2 describes the polling of a busy DXE;
- para 2.4.4.7 describes what to do if an RNR-frame is received;
- para 2.4.4.9 describes the waiting for acknowledgement procedure.

The intended use of RNR is highlighted by the wording of para 2.3.4.2.2, in which the key words are "temporarily busy". The procedure defined for using RNR is meant to be used to recover from a situation in which a TNC is unable to handle any more information due to a short-term problem, such as the host accessing disks or similar. It was never designed to handle the long-term situation in which a TNC becomes busy for long periods whilst unattended. The future implementation of Level 3 and higher software will not resolve this problem as the busy condition is not reported to higher levels.

### The cure

The only cure within the present specification is to ensure that the level 2 software never gets into a busy condition. There are several ways of ensuring this:

- When memory fills up, new text overwrites the oldest data stored in RAM. When the operator allows host communication to resume he sees only the last RAMs worth of information. This would need a rewrite of present TNC software.
- When the memory is full, all incoming information is discarded. The MONITOR function is suspended until memory becomes available. When the operator allows host communication to resume he sees the first RAMs worth of information which was received after he left the TNC. This would also need a rewrite of present TNC software.

### What the operator can do

To alleviate the problem, users of present TNCs should observe the following:

- NEVER leave a TNC unattended with MONITOR ON and control-S issued.
- When connecting to an unattended TNC,



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leave short messages only: I-frames can fill the memory as well as monitored frames. If you want to transfer a file, leave a message to say that the file is available and have the other station call back when he is available.

C. If your host computer has a large buffer capability, leave the host switched on and allow the TNC to output into this buffer, rather than store incoming data internally.

#### More Fundamental Changes

The recovery time from a TNC becoming busy when unattended can be improved by some minor changes to the AX.25 specification. The following are *SUGGESTIONS* and represent the personal view of the author only:

1. If a DXE is busy and disconnected, it should respond to a SABM-frame with a DM-frame; i.e. an attempt to connect to it should get a busy response. This would need an additional state (17) in the state table which would correspond to "device busy and disconnected". When in this state, its responses would be as state 1 except that the response to a SABM would be a DM and no state transition. This response is already implemented in the WABED software for the TNC-1, although not by the method described above.

## PACKET GROUP NEWS

**ARRAC**  
Membership is now (5 November) up to just over 400. Currently producing packet radio guidance literature, starting with an intro to the TNC-2. The project is coordinated by Mark, G4ZRT, who would like inputs on GLB and TNC-1. The group is also setting up a telephone "help-line", to assist newcomers in getting going with their brand new TNCs.

The ARRAC Convention is scheduled for 21-22 March 1987, at a hotel in Birmingham. They are planning a full seminar with guest speakers, equipment reviews, demonstrations, workshops, and day trips for partners. The probable cost will be around £35 per head, including 4-star accommodation, Saturday lunch and dinner, Sunday breakfast and lunch. Phil Bridges, G6DLJ, (not G1HR - address in last month's CI) needs to know as soon as possible who plans to attend.

ARRAC are also organising a bulk purchase of 70cm Pye PF70 Pocketphones, modified by a professional engineer to work

2. A DXE in state 5 (information transfer) which is connected to a device that becomes busy and as a result moves to state 9 (remote becomes busy), should go through the procedure described in para 2.4.4.7, but on moving to the waiting act. procedure described in para 2.4.4.9, instead of using T1 continually, should use an exponentially increasing time starting at T1 and ending at T3 seconds.

The problem should then be reported to a higher level, or to the operator, and retries continued at the T3 rate.

3. A DXE in state 8 (device busy) which becomes not busy should act as shown in Fig A3 in the specification; i.e. it should send an RR-frame to inform the other station that it is ready to resume I-frame transfer and move to state 5. Similarly, the remote device, on receiving an RR-frame should respond as defined in Figs A1 and A2. This does not require any change to the existing specification.

#### In conclusion

The RNR problem is not really a problem at all, but a small extension of the specification would improve system throughput by removing prolonged RR/RNR handshaking which is becoming increasingly common as activity increases.

on 432.675 MHz, and providing a direct TNC connection. Price £40. Details from G6DLJ.

Finally, G6DLJ is setting up a new company to supply Pac-Com TNCs in the UK. First offering will be the TNC-220, a newly designed successor to the popular TNC-200. The 220 has two radio ports (for HF and VHF), a 7910 single-chip modem, active HF band pass filter, optional tuning indicator, modem disconnect header. Deliveries start December, and prices start at under £135.

#### MAXPAK

The group hopes to give talks/demonstrations to West Bromwich ARC, Salop ARC, Sutton Coldfield Club (26 Jan 1987), and Stafford Club. At the group meeting on 23 October, length and frequency of beacons was discussed. It was agreed that the maximum length should be about 30 characters, and that a sensible period between beacons should be about 15 minutes. Use of the Bell character was deprecated. Next MAXPAK meeting is on 20 November in Wolverhampton. Details from Andy, G1DLI.

## SWAX25 MEETING REPORT

From: Ed Harland, G3VVF

6 October 1986

Meeting held at Crewekerne on 2 October 1986. 22 members present. Groups represented included G5EFP (Exeter), G5GSP (Bristol), G5GDB (Horniton), G5GDP (Weymouth) and G5GPF (Winchester).

The meeting opened with the chairman, G5EWM, inviting G8IMB, the RSSB RMS data repeater specialist, to make a statement on the present packet switching station (PSS) licence applications. G8IMB said that 14 proposals were submitted (see last month's CI for the details). A definite requirement would be identification of the PSSs in Morse every 15 minutes. The RSSB would be happy to consider a second phase of licences, but no proposals had yet been received.

G1DII read out a letter received from G3VAD regarding the choice of 144.650 MHz for the PSS network. He was worried that if the UK used 144.650 MHz then the network would be incompatible with the continental usage of 144.675 MHz. G8IMB pointed out that there is no IARU band plan for the packet network. The RSSB had chosen 144.650 MHz to avoid the IARU data calling channel on 144.675 MHz. It was hoped that the next IARU conference would provide guidance in this area, but until then the UK would take the lead and not licence PSSs on the data calling channel (which is also used by RTTY, Casbridge packet, etc). The second channel on 145.275 MHz was allocated to allow for future expansion and multiple frequency experiments.

The discussion then moved on to consider what functions should be provided by the PSSs. G3VVF said that the PSSs on good sites should provide only minimal facilities, such as activity lists, over and above the basic digipeat function. In particular, the use of bulletin board and mailbox systems should not be implemented by the well sited PSSs in order to avoid excessive channel occupancy.

G4ZRT said that he favoured the PSSs implementing full mailbox facilities on 144.650 MHz whilst simplex activity should remain on 144.675 MHz. A lively discussion followed with no definite conclusion, although it was agreed that during the experiment period the different approaches should be tried, but that if problems were experienced then the PSS groups should be prepared to change their systems to optimise network performance.

Following the PSS discussion, several present expressed a desire for a guide to

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packet operating. To illustrate the need, G5EWM read out a letter he had received from a station who had come onto packet but was struggling to get to grips with packet operating. Suggestions for topics to be covered by such a document included:

- File transfer techniques
- Use of beacon mode
- Methods of disconnecting
- Use of CTEXT and BTEXT
- Use of RETRY
- Set 3 E 0 when tuning off-channel
- Interaction effects

G6DLJ said that ARRAC were hoping to publish such a document and that it would appear in "ARRAC User" in due course.

The chairman then opened the meeting to topics from the floor:

G3VVF asked if anyone knew of work in the UK to develop 9600 bps equipment. It was suggested that UDS (University of Surrey) may be active in this area.

G8IMB made a strong plea for the PSS groups to experiment as much as possible during the initial period that the PSSs would be licensed. In particular, we needed to gather as much information on linking as possible. G4ZRT said that the ARRAC group were developing hardware for microwave linking and were already looking at dual-frequency access mailboxes.

G4ZRT said that he had various versions of Level 3 software available from the USA if anyone wanted to experiment with networking.

G1DII said that he believed the French were to hold a meeting in the near future to plan their national packet network. He would endeavour to try to get the details for those who expressed an interest in attending.

G3VVF asked if anyone was equipped and ready to use the JAS-1 satellite packet repeater when it becomes operational. It appeared that no-one was, and that there were no immediate plans to become so equipped.

G5EWM reported that the SWAX25 stand at the Torbay rally had been very successful. Much interest had been shown and the group had been invited back next year. He hoped that with the rapidly increasing activity levels, the local group would be able to put on their own display next year.

To illustrate the increase in interest in packet over the last few months, G6DLJ said that since the last SWAX25 meeting the ARRAC membership had increased from 90 to 300.



# WAB SQUARES FOR DIGIPEAT PATHS

From: Mack Lindenbergh, G1DX1  
MAXPAX "Digicom" September 1986

There are a number of schools of thought at present as to how to simplify the process of creating a usable digipeat path. In your own home area this does not really present a problem, as variables such as operating times of a particular digi station, operating range, antenna system and the like are usually known. Also, experience of using the same people as digis gives one a certain amount of local knowledge.

When considering a long digipeat path out of your local territory, then things become a little more intricate. The possibilities of a station being off-air can create problems, even if you know the path.

What do you do if you do not even know the call sign of the station you wish to digi through? Now the numbers of variables are beginning to mount up.

To try to rationalise the situation, I would be interested to discuss with anyone the possibilities of using the worked All Britain (Ordnance Survey) locator system as a basis for a digipeating system. Everyone on mainland UK is sited within a recognised Ordnance Survey square as used by WAB, so if, for instance, Robin, G4BBR, in Cheltenham wished to work Ron, G8DVR, in Liverpool, then his nearest digi point would be around the Wolverhampton area (some 4 WAB squares).

Now if Robin had no idea who was operational in Wolverhampton that evening, rather than work systematically through his list of operational MAXPAX stations, he need just select a square reference. At the most he will only have to make four attempts to cover all the stations who could be active in Wolverhampton.

Of course, to make this work, each packet station has to set his MYALIAS to the appropriate WAB reference. In the case of square SJ08 for example, where there are two operators, the alias would be set to SJ08-1 for the first station, and to SJ08-2 for the second, etc. etc.

By using a wall mounted Ordnance Survey map showing the WAB squares it should then be a fairly simple operation to determine a dx digipeat path. In fact I am sure someone will now sit down and write a computer program to do the donkey work for us. It must be viable, as it is only calculating point to point on a grid, where hops are requested every, say, 25-30 miles. Any offers?

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If you extend this idea to an international locator scheme like Maidenhead instead, we could be on the right track - G3NMRJ.

## INTERCEPTING TNC COMMANDS

From: Phil Green, G4PHL  
16 October 1986

Here in the Sheffield area we have only four regular stations, but we have reliable contact with the Lincoln lads, increasing the size of the group to about seven or eight in all. There is talk of forming a repeater group, and a search is now under way for a suitable site.

Pieter Meiring's (G0BSX) board has generated considerable interest among the locals. My current projects include a 280 serial, and conversion of a printer to 300 bps serial, so I can now monitor on a 24-hour basis without tying up the astro.

Right I make a plea for CD callers to turn off their "sorry I can't talk..." type of connect messages first? Another pet niggle is continual CD calls, using "B E I" or similar commands.

Surely everyone is monitoring on a display of some sort, making multiple calls unnecessary? I think three calls are sufficient to attract the attention of a monitoring station.

I have a proposal to make to all existing or prospective terminal software writers, which is this:

When trying to compile a list of stations to form a digipeated chain over a long distance, it is very difficult to assess the coverage of each station. I can hear G3TND, but who can he hear? Perhaps a GM, but then who can the GM hear? I would like to be able to ask a remote TNC for its PHEARD list. The initial proposition, therefore, is that any text enclosed in { } curly brackets be intercepted by the terminal software, and issued as a command to the TNC. The TNC's reply (for example, the PHEARD list) would then be sent back over the link to the calling station.

In this way a multi-hop link could be set up very quickly, and alternatives established should a station have closed down. I have incorporated this and other ideas into my own software, and it seems to be a desirable feature.

# UK PACKET DIRECTORY UPDATE

8 November 1986.

Total: 323 stations

The following stations have been added to the directory since C1/Oct86.

CALL	NAME	LOCATION	TNC
G0CFM	John	Cookham, Berks	TNC2
G0CYB	Paul	Mansfield, Notts	BSX
G0MVB	Boyd	Exeter, Devon	TNC200
G1NTH	Ronnie	St Neots, Cambridg	TNC200
G1DLN	Andy	Havant, Hants	TNC200
G3AAJ	Ron	London, E12	MFJ
G3BBA	Dliver	Berwick-on-Tweed	
G3CCH	John	Scunthorpe, S Humberside	TNC200
G3160	(Club)	Surrey University	
G3CDJ	Malcolm	Wolverhampton, W Midlands	TNC200
G3NDO	Pesi	Hayling Island, Hants	PK80
G3NNE		Taunton, Somerset	
G3PAQ	Doug	London, SW18	TNC200
G3TUD	Edward	Gainsborough, Lincs	
G3TUX	Chris	Haslemere, Surrey	PK64
G3VJ2	Allan	London, N9	TNC200
G3JDI		Welwyn Garden City, Herts	TNC200
G4APL	Paul	Caterham, Surrey	TNC200
G4ATP		Taunton, Somerset	
G4PCN		Norton Abbot, Devon	
G4TTF	Mick		
G4NSC	Douglas	Ware, Herts	TNC200

## Late entries

G4SGG Dave Nottingham BSX

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Air (B)	£ 9.24	£ 10.87
Air (C)	£ 9.60	£ 11.29

Air (A) = Middle East, North Africa.  
Air (B) = North and South America, Africa (except North Africa), Asia (except China, Taiwan, Japan, Indonesia and Korea).  
Air (C) = Australasia, Pacific Islands, China, Taiwan, Japan, Indonesia and Korea). Payment by cheque or money order in pounds sterling to RSGB, Lambda House, Cranborne Road, Fotters Bar, Hertfordshire, EN6 3UE, England.

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G4MNS	Maurice	Seaford, Sussex	
G4MDK	Colin	Norwich, Norfolk	TNC200
G4DAK	Steve	Storrington, W Sussex	TNC200
G4RIA	Ken	Huddersfield, W Yorks	
G4UCP		Leeds, W Yorks	
G4UHG		Bristol, Avon	
G4ZAT	Geoff	Harrogate, N Yorks	PK64
G6GLP		Norton Abbot, Devon	
G6GPV	Ken	Southampton	
G6NLM		W Chillington, W Sussex	
G6VMT	Basil		TNC200
G6XDB	Ray	Napthill, Bucks	TNC200
G6BAK	(Club)	Surrey University	TNC200
G6BKE	Chris	Witham, Essex	TNC200
G6CAR	(Club)	High Wycombe, Bucks	
G8DJD	Bryan	Caterham, Surrey	TNC200
G81YI	Nigel	Scunthorpe, Lincs	
G8LGI	John		TNC200
G8XJF	Jack	Prestwick, Ayr	
G8JFA	Eric	Ft William, Inverness	
G8AFI	Dave	Ft William, Inverness	
G8APL			
G8AKS	Jack	Prestwick, Ayr	

Particular thanks to Malcolm Bassil (G4AGU), Martin Briscoe (G8BAQ), John Danks (G5DS), and Reg Brake (G8BR) for supplying much of the update information to the directory. Please send details of any changes or additions direct to G3NMR.

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## COPY DATE FOR THE NEXT ISSUE

Monday 8 December 1986

Please send all copy direct to:

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Dunstable, Beds, LU5 6NF, UK.  
Prestel MBX: 21999745



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Enclosure D

NOORDWIJKERHOUT

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Committees A and B

document NN/35

## PACKET RADIO TRANSMISSION STANDARDS

RSGB

[United Kingdom]

### INTRODUCTION

When deciding upon standards for packet radio transmission there are two separate requirements:

- i) 300 bit/s for HF, and for poor VHF/UHF paths
- ii) 1200 bit/s for good VHF/UHF paths

There is no requirement for common standards between existing 45/50/75 baud RTTY and packet radio. Thus standards may be chosen which are most appropriate for the intended requirements.

### DISCUSSION

Most of the available Terminal Node Controllers (TNC) include one of the standard "single chip" modems which are only capable of supporting the professional CCITT and Bell transmission standards, and do not cater for existing IARU recommended RTTY standards.

For HF operation, the basic mode of operation is that of narrow shift FSK (mode F1D) supporting a relatively low data rate, so as to conserve spectrum. For VHF/UHF operation, it is also possible on some paths to use wider shift FSK (mode F1D) or AFSK (mode A2D, F2D and G2D) thus allowing higher data rates.

When using AFSK on the VHF/UHF bands at up to 1200 bit/s, the choice is between the CCITT V23 mode 2 standard (1300/2100Hz), and the Bell 202 standard (1200/2200Hz). In 1984, in the absence of IARU recommendations, and following discussions with interested parties, RSGB adopted the Bell 202 standard for data rates between 300 and 1200 bit/s.

When using FSK on the HF bands, in order to generate the final FSK signal from an SSB transmitter, the choice is between the CCITT V21 standard and the Bell 102 standard, both of which use a 200Hz frequency shift to support data rates of up to 300 bit/s. Both CCITT V21 and Bell 201 specify two pairs of tone frequencies so that duplex operation can be achieved over a two-wire telephone circuit. These two modes are referred to as the "originate" and "answer" modes, the "originate" tone pair normally being the lower in frequency.



Any of these four tone pairs (CCITT V21 or Bell 201, originate or answer) would be suitable for final FSK generation using an SSB transmitter. However on VHF/UHF, AFSK may also be used with these tone pairs at data rates of up to 300 bit/s, and in these conditions there are advantages in using the lowest frequency tone pair to minimise transmitter bandwidth. Thus it is suggested that the CCITT V21 "originate" mode be used for transmission.

# PROPOSALS

It is proposed that the following standards be adopted by Region 1 for packet radio data transmission:

HF	F1D	up to 300 bit/s	200Hz shift	
VHF UHF	F1D	up to 300 bit/s	200Hz shift	
	F1D	300 to 1200 bit/s	1000Hz shift	
	A2D F2D G2D	up to 300 bit/s	200Hz shift	Low tone - 980Hz High tone - 1180Hz (CCITT V21 ORIGINATE mode)
	A2D F2D G2D	300 to 1200 bit/s	1000Hz shift	Low tone - 1200Hz High tone - 2200Hz (Bell 202 standard)

## Notes

The HF transmission mode (F1D) and the F1D VHF/UHF mode with 200Hz shift may be generated by using the CCITT V21 "originate" mode with an SSB transmitter switched to upper sideband.

The F1D VHF/UHF mode with 1000Hz shift may be generated by using the Bell 202 standard with an SSB transmitter switched to upper sideband.



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Committee B

document NN/41

## PACKET RADIO STANDARDS

SRAL  
[Finland]

We hereby suggest the following proposals to be discussed and adopted in Region I:

## Protocol

AX.25 only should be used in amateur packet radio as link level protocol.

## Reason:

AX.25 has already become a de-facto standard. Presently all commercially produced units adhere to it.

## Modems

1200 bits/s :	CCITT V.23 main channel (1300/2100 Hz, FSK)
300 bits/s :	CCITT V.21 orig. channel (980/1180 Hz, FSK)

## Reason:

The CCITT modem recommendations are accepted world-wide in telecommunications (except some types in North America). It would therefore be appropriate to use them in amateur radio as well. Bell-type modems should not be used in Region I unless communication cannot be otherwise maintained.

The V.21 frequency shift (200 Hz) is equal to what is used on HF at present. Using V.23 on 1200 bit/s does not cause much concern, if Region 2 would decide to use Bell 202 modems also in the future, as the traffic is local. International connections should be executed either via satellite or high-speed links, both of which will require special gateway stations.

The probability of finding high quality surplus modems in Region I, used in the switched telephone service, is much higher if also amateur radio is using CCITT recommendations.



## Modulation

For normal use, up to 1200 bits/s, FSK modulation and NRZI encoding should be used. For higher transmission rates PSK or other advanced modulation techniques should be used.

### Reason:

Up to 1200 bits/s FSK modulation is technically quite adequate and should therefore be used, as it is far more economical and easier to realize than PSK, at least presently.

For satellites and other specialised use, where high quality is important, also other modulation techniques could be contemplated.

## Frequencies

145.300 MHz in the 145 MHz FM band, should not be used by packet radio communications. This frequency is allocated to RTTY, with which packet radio is totally incompatible, both communication modes causing each other severe interference.

145.225 MHz is proposed to be used for point-to-point compound FM packet radio communications, at least on temporary basis, as it is largely used for that purpose in all Scandinavia at present.

## Bandplan

The bandplan discussed in Vienna at the VHF managers meeting 1986 is proposed to be adopted, slightly revised:

144.675 MHz centerpoint of band for point-to-point packet radio communications

145.225 MHz packet radio communications, compound FM

145.300 MHz RTTY and RTTY mailboxes

432.600 MHz RTTY

432.750 MHz center point of data communications band, FSK

433.600-433.675 MHz band for data communications, compound FM

433.650 and 433.675 MHz digipeater channels

433.600 MHz RTTY mailboxes





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Committee B

document NN/110

AX.25 FREQUENCY ALLOCATION ON VHF and UHF

NRRL

[Norway]

OBSERVING

- that digital communication is a modern, fascinating technology and a challenge to the amateur radio world.
- that Packet Radio based on the AX.25 protocol has been established as a worldwide amateur radio standard for digital communication.
- that AX.25 local networks and digital links on VHF and UHF uses 1200 baud AFSK with tones 1200/2200 Hz according to CCITT V.23 or Bell 202 modem standard. On FM the deviation will be 3 - 5 kHz.

CONSIDERING

- that participating in AX.25 only calls for a terminal node controller (TNC) connected between an ASCII-terminal or Home Computer and a VHF/UHF FM rig.
- that AX.25 activity is growing fast and numbers by april 1986 15.000 stations in the U.S. In Norway the number of active radio amateurs has increased from 2 to 100 during 1985. It may well be that within the end of 1987, 10% of the active Norwegian radio amateurs will be on packet.
- that AX.25 networks combined with Bulletin Board Systems (BBS) and UHF/VHF/HF or satellite Gateways, can be used for fast and reliable information distribution for radio amateurs providing updated information for instance on DX activity, propagation, test rules and results, news bulletins, satellite schedules and databases (QSL managers, DXpeditions etc.).
- that the AX.25 system provides a potential for excellent emergency communication provided by radio amateurs.
- that the Carrier Sense Multiple Access (CSMA) principle used in AX.25 allows for multiplexing of several simultaneous digital links on the same frequency. However, as traffic increases and the frequency carries too many links, more than one frequency must be used.



- that the AX.25 protocol will be further developed for use in advanced digital networks.

#### RECOGNIZING

- that the expanding AX.25 activity creates a demand for frequencies in the VHF and UHF bands.
- that the widespread presence of 145 MHz FM equipment among radio amateurs makes this band the most attractive choice in order to cut costs when joining the AX.25 activity.
- that AX.25 is a very powerful and flexible system, to be further developed by radio amateurs and used in experiments with digital networks and transmission via digipeaters and high speed links. By establishing networks on VHF/UHF and links over satellite or HF radio the radio amateur will gain experience with digital protocols and network management.
- that the promotion of AX.25 will enhance the need for and benefits of standardization as the system is further developed.

#### RESOLVES

- that there should be provided for AX.25 FM activity in the 145 MHz and 432 MHz bands.

#### RECOMMENDS

- that the bandplan should recommend the following usage of the listed frequencies:

##### 144 - 146 MHz Bandplan:

Freq.:	Usage:
145.200	- AX.25
145.225	- AX.25
145.250	- AX.25 Digital Links
145.275	- AX.25 Digital Links
145.300	- AX.25 or RTTY

##### 432 - 438 MHz Bandplan:

Freq.:	Usage:
433.600	- AX.25 or RTTY
433.625	- AX.25 or RTTY
433.650	- AX.25
433.675	- AX.25 Digital Links
433.700	- AX.25 Digital Links
433.725	- AX.25



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Committee B

document NN/136

## FREQUENCIES FOR PACKET RADIO

### RSGB

[United Kingdom]

#### PROPOSAL

That the long term aim shall be to establish formal packet repeater (digipeater) networks in the 432MHz band and that the 144MHz band be used for experimental networks in advance of any large-scale formal network. It is further proposed that horizontal polarisation be used by all packet radio repeaters.

#### DISCUSSION

Packet radio is gaining in popularity, particularly since the adoption by ARRL of the AX-25 protocol, and the greater availability of terminal node controllers (TNC). At present the majority of communication is point-to-point, but one of the advantages of packet radio is the ability to build networks of intercommunicating stations, allowing messages to be passed across the country to a final destination.

Any TNC may, subject to a country's regulatory conditions, act as a packet radio repeater, and store-and-forward messages to another TNC. Such TNCs may be regarded as an "informal network", established by individuals in a non-structured way. In addition, permanent repeaters consisting of a TNC and associated computer may be established as a "formal network".

Whilst there is no practical way of preventing informal networks from being established on any band, due to the pressure on frequencies in the 144MHz band it is proposed that the long-term aim shall be that no formal networks be established in this band. Instead, it is recommended that the 432MHz band be used for formal packet radio networks. Since the majority of packet radio communications is between fixed, rather than mobile, stations, the use of 432MHz rather than 144MHz should cause few problems of coverage.

However, it is recognised that many stations are currently equipped for packet radio on the 144MHz band, and in order that packet networks be established quickly to enable problems of packet routing and network management to be resolved as quickly as possible, it is recommended that the 144MHz band be used for interim experimental networks.

In addition, to encourage the use of directional aerials by stations in order to reduce co-channel interference, it is proposed that all packet radio repeaters use horizontal polarisation.



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HOOGVERBODEN TOEGANG TOT DEZE DOCUMENTEN

NOORDWIJKE RIJCHT

Committee HF

document NN/147

RESOLUTION 86-2 - CONCERNING PACKET RADIO OPERATION

A.C.

The Administrative Council, Buenos Aires, October 1986.

CONSIDERING:

1. the increasing interest in, and rapid development of, packet radio;
2. the promise that packet radio holds for the accurate and efficient transmission of data;
3. the desirability of continuing the development of packet radio, and
4. that the popular amateur bands are already fully utilised by amateur stations using other modes of emission.

NOTING that the International Secretariat has been requested by the Administrative Council to serve as international clearing house for information concerning packet radio:

RECOGNISING:

1. that international and domestic regulations limit the handling of third-party traffic by amateur stations, and
2. the potential for harmful interference by unattended HF stations and the need for adequate technical and regulatory safeguards:

RESOLVES:

1. that member societies and individual amateurs engaged in developmental work in packet radio are hereby congratulated for their contributions, and are urged to continue their efforts:
2. that member societies are urged to encourage amateurs in their countries to confine route HF packet radio operations to the segments of the bands designated for RTTY and similar modes:
3. that developmental work that takes place outside the RTTY sub-bands should be confined to one frequency per band, with the frequency to be designated by the International Secretariat for international communications after consultation with the regional organisations, and by the member societies for domestic communications after due consideration of regional band-plans, international and domestic regulations, and the desirability of minimising interference to stations using other modes of emission.



4. that member societies are urged to address, through their regional organisation, the need for specific provisions for packet radio operation in their band plans consistent with worldwide activity:
5. that the International Secretariat is requested to continue its work in response to Resolution 85-7, and, if possible, to render a report at lease 30 days prior to the next meeting of the Administrative Council.



# THE INTERNATIONAL AMATEUR RADIO UNION

## REGION 1 DIVISION CONFERENCE

12-17 APRIL 1987

Document of the 1st Session

NOORDWIJKE RHODI

Committee B

document NN/158

### RTTY, MAILBOXES AND PACKET RADIO MATTERS

UBA

[Belgium]

#### 1. General

- [a] Although UBA supports the Vienna decision to set up packet radio networks on 430MHz and higher, some of our members feel that they should be allowed to continue experiments [no networks!] on other frequencies other than the agreed 144.675MHz [FSK] or 145.3MHz [AFSK/FM]. We think this might be possible, provided the bandplans are strictly adhered to [e.g. no broad signals or vertically polarised below 145MHz, or outside the all-modes part], and want to discuss this in Committee B.
- [b] Belgian packet users propose to follow specifications recommended by ARRL concerning protocol structure and frame format, as well as future developments in line with USI-ISU.

#### 2. Standards

- [a] Antenna polarisation should be horizontal for packet radio repeaters.
- [b] Mailbox planning is to be considered with digipeaters and gateways in mind. We propose to extend the Vienna decision to use 145.3MHz for FM/AFSK packet radio mailboxes as follows:  
  
Mailboxes [RTTY, AMTOR or PACKET] - 145.2125 to 145.3MHz  
[digipeaters NOT recommended]
- [c] Mailbox access procedure. We disagree with the idea of a "same software procedure" as put forward [but not accepted] in Vienna [Minutes page 12, point 4.4.7. Draft]
- [d] Modulation and Speeds. We support the following standards:
  - 1. RTTY-CCITT Nr 2 [Baudot code]. F1B and F2B modulation with shifts of 170Hz or 850Hz at standardised speeds of 45.45, 50, 75 or 100Bds. Mark should be the highest radio frequency, also in F1B on VHF.



2. RTTY-CCITT Nr 5 [ASCII code] F1B and F2B modulation with shifts of 170Hz or 850Hz at speeds of 110 [preferred], 150, and 300 Bds... Same remarks as with Baudot.

A 1200 Bps speed could be adopted provided that the Bell 202 main channel or Kansas City 1200/2400Hz [MSK] be used.  
[Compatibility packet radio or satellite modems].

3. For AMTOR [mode A,B or L] [As CCIR 476-2 Recommendation]: F1B and F2B modulation with shifts of 170 or 850Hz and a speed of 100 Bps. Same remark as above on mark and space frequencies.

4. For packet radio: F2D modulation with Bell 202 standard [main channel] and a speed of 1200 Bps.

F2B and F2D modulation only to be used where F3E [narrow band voice FM] is allowed in the band plan.

Higher speeds [e.g. 300 and 1200 Bd ASCII] should be recommended in order to keep the occupation time of mailboxes as short as possible. There is no need for new standards such as proposed CCITT V25. All new standards should be in line with IARU/ARRL recommendations.

[e] Designations of emissions: We propose to use only the new designations from ITU Radio Regulations [August 1982 - RR4-1 to RR4-4] as specified by WARC 1979, including details of bandwidth, type of signals, and nature of multiplexing in all AIRU reports.

### 3. Proposals for band planning

1. We propose to allow packet users to experimentally use the segment 144.5 to 144.8MHz with respect to reserved frequencies and segments, accepted modulation and corresponding bandwidths and antenna polarisation.
2. We propose to adopt 144.675MHz + or - and 432.675MHz + or - as "DX packet calling frequencies" [narrow band FSK mode or 170HF30]
3. Mailbox frequencies: We propose to use the following segments for mailbox use in FM [RTTY, AMTOR, and Packet]:  
145.2125 to 145.3MHz and 433.85 to 433.925MHz

### 4. Digipeaters and RTTY relay frequencies

1. Digipeaters should use 430MHz and higher bands [Vienna '86].
2. We see no use for RTTY relay channels [repeaters].

### 5. Networks planning

1. Protocols and rules on packet radio. TNCs, repeaters, etc. should preferably be handled by a special commission for data transmission working in relation to existing study groups.
2. A gateway planning should be adopted to facilitate trans-border internetworking [e.g. frequency coordinator as for 28MHz beacons].



spirit of the Region 3 position concerning visits to administrations, and were very cost-effective.

8.1.4) Region 3 requested that the Administrative Council prepare a document detailing for member-societies the objectives being pursued, and the action they should take in support. It was agreed that at this time, the letter to be sent by the President adequately addresses the point. Another request from Region 3 was that records be maintained to indicate the progress of preparations; it was agreed that this is the responsibility of the regional organizations. It was further noted that WARC-79 was thoroughly documented, and that perhaps the President should reissue the paper documenting WARC-79 preparations that was circulated after the Conference. Mr. Fujioka noted that member-societies are not generally aware of the significance of ITU conferences, and that efforts should be made to explain the significance of each conference to radio amateurs. It was noted with satisfaction that the budget for Region 2 adopted at its recent conference makes provision for expenses related to possible WARC preparations for the next three years, in accordance with "resolves 6" of Resolution 85-4.

8.2) Possible improvements to the IARU Constitution and Bylaws (Resolution 84-3). It was noted that the recent Region 2 Conference had supported the existing structure of the IARU Constitution, and had entrusted to its Executive Committee the determination of what minor changes might be desirable. The Region 3 Conference last year had considered submissions by RSGB, WIA, and NZART, and had adopted a paper which had been sent to the International Secretariat for circulation to the regions in accordance with "resolves 2" of the resolution. Region 1 is prepared to take up the matter at its conference next year.

8.3) The Secretary reported that because of small response from member-societies to the request for input on packet radio regulations, and recent changes in the rules governing packet radio operation in the United States, it had not been possible to complete meaningful work on the report called for in Resolution 85-7 in time for this meeting. Only three member-societies responded to the request contained in Calendar No. 135: those of Austria, Switzerland, and Italy. A discussion of the situation regarding HF packet radio operation ensued, after which the President designated Messrs. Sumner and Shaio to draft an appropriate resolution for consideration on the following day.

8.4) A proposal for a modification to Resolution 85-1 was considered. After discussion, the following modifications were agreed to:

1. "Resolves 1" is amended to read as follows: "1. The segment 28.190 to 28.200 MHz will be assigned as time-sharing frequencies for the International Beacon Project, effective immediately."

2. "Resolves 8" is numbered "9."



6. The IARU International Beacon Project Coordinator will submit to the International Secretariat the technical parameters for the beacons as well as the specifications for the regional networks, information that will be sent to all member-societies. He will be responsible for frequency management, for time allocations and will strive for global coverage.
7. The Administrative Council will insure that this new scheme of 28-MHz beacons as well as any other beacon systems in other bands will be adequately publicized and that the data collected from the operation of the beacons will be distributed regularly to all member-societies.
8. The segment 28.200-28.225 MHz will be reserved for use by continuous-duty beacons, to be approved by the IARU International Beacon Project Coordinator on a case-by-case basis after a satisfactory showing of special need.
9. Beacons operating outside of the new system will cease to be protected from interference by IARU band plans on 1 January 1990.

8.5) Other resolutions previously adopted by the Administrative Council were reviewed as follows:

Resolutions 84-4 and 84-5. These subjects are scheduled for consideration by Region 1 at next year's conference.

Resolutions 85-2, 85-3, 85-6, 85-8, and 85-9. These are continuing resolutions. A typographical error was noted in Resolution 85-3; the reference should be to Resolution 84-2, not 84-1.

Resolution 85-5: Review is scheduled for after 1 January 1987.

The Council adjourned for the evening at 6:00 P.M., reconvening the following day (Monday, 27 October) at 9:19 A.M. with all members present.

Returning to agenda item 8.3, Messrs. Sumner and Shaio presented a draft resolution which was adopted after discussion:

#### Resolution 86-2

##### concerning packet radio operation

The IARU Administrative Council, Buenos Aires, October 1986,  
considering 1) the increasing interest in, and rapid development of,  
packet radio;



- 2) the promise that packet radio holds for the accurate and efficient transmission of data;
- 3) the desirability of continuing the development of packet radio; and
- 4) that the popular amateur bands are already fully utilized by amateur stations using other modes of emission;

noting that the International Secretariat has been requested by the Administrative Council to serve as international clearing-house for information concerning packet radio;

recognizing 1) that international and domestic regulations limit the handling of third-party traffic by amateur stations, and 2) the potential for harmful interference by unattended HF stations and the need for adequate technical and regulatory safeguards;

resolves 1) that member-societies and individual amateurs engaged in developmental work in packet radio are hereby congratulated for their contributions, and are urged to continue their efforts;

2) that member-societies are urged to encourage amateurs in their countries to confine routine HF packet operations to the segments of the bands designated for RTTY and similar modes;

3) that developmental work that takes place outside the RTTY subbands should be confined to one frequency per band, with the frequency to be designated by the International Secretariat for international communications after consultation with the regional organizations, and by the member-societies for domestic communications after due consideration of regional band plans, international and domestic regulations, and the desirability of minimizing interference to stations using other modes of emission;

4) that member-societies are urged to address, through their regional organizations, the need for specific provisions for packet radio operation in their band plans consistent with worldwide activity;

5) that the International Secretariat is requested to continue its work in response to Resolution 85-7, and if possible to render a report at least 30 days prior to the next meeting of the Administrative Council.

Mr. Sumner noted that since March, ARRL had been preparing a request to be filed with FCC for Special Temporary Authority for operation by a limited number of unattended HF packet radio stations for the purpose of promoting further development and assessing the interference potential of the mode. The approach



being followed is similar to that used for the development of slow-scan television in the late 1960's. Authority to operate on no more than one frequency per band is being sought. If the consultation called for in Resolution 86-2 can be completed quickly, the requested frequencies will be selected so as to be in alignment with those to be selected in accordance with the resolution. //

It was agreed that consideration of agenda item 9 would be deferred until later in the day.

10.1) After discussion of the status of the International Beacon Project Coordinator, the Administrative Council reconfirmed that the International Beacon Project be continued under the leadership of Region 1, as in the past, and that the International Beacon Project Coordinator designated by Region 1 continue to serve on behalf of the Administrative Council as well; and that John Troster, W6ISQ, is named to assist Region 1 in implementing the revisions described in Resolution 86-1. The International Beacon Project Coordinator and Assistant are instructed that they are not to engage in communication with bodies outside the IARU on matters relating to the International Beacon Project until terms of reference for the International Beacon Project have been adopted by the Administrative Council. It was agreed that the Secretary would write to the individuals concerned to inform them of this action.

10.2) The Region 3 request that the Administrative Council encourage the continued participation of IARU in the work of the CCIR, and to urge member-societies not yet so involved to become participants in their national Study Group 8 activities and CCIR conference preparatory work, was noted. It was further noted that "resolves 6" of Resolution 85-4 addresses this subject, and that it had also been addressed earlier in this meeting.

10.3) The Administrative Council took note of the work being done by Region 3 with regard to collecting information on radio legislation, and commended the region for its leadership in this area.

10.4) Consideration of the subject of Constitutional interpretations was postponed, to be dealt with together with agenda item 9.

10.5) Agenda item 10.3 of the 1985 meeting was reviewed. The regional organization had fulfilled its responsibility in attempting to gather information, but information was still incomplete. It was determined that the matter should continue to be monitored closely by the regional organization.

A review of the performance of IARU member-societies by region identified non-performing societies in the following countries:

Region 1

Angola  
Ghana  
Mozambique  
Swaziland  
Zaire

Region 2

Belize  
British Virgin Islands  
Dominica  
Guyana

Region 3

Burma  
India  
Western Samoa



UNION INTERNACIONAL DE RADIO AFICIONADOS

IX ASAMBLEA GENERAL

REGION II


**BAIRES 86**  
**CARLS**

OCTOBER 20-25, 1986

INTERNATIONAL AMATEUR RADIO UNION

9th GENERAL ASSEMBLY

FROM: A R R LTO: COMMITTEE A-B-CSUBJECT: PACKET RADIO IN REGION 2

PAGE 1 OF 8

DOC/BA-041-E

There are now about 18,000 packet-radio terminal-node controllers (TNCs) in the hands of amateurs worldwide. This is in contrast to an estimated 6000 at the time of the Region 3 Conference less than a year ago. A geographical breakdown of the 18,000 is not available, but most are in the United States for now. Nevertheless, packet-radio is now coming into use around the world, including throughout the Americas. This relatively new Amateur Radio mode holds the promise of a global network that will enable amateurs using personal computers to exchange data rapidly and without errors. The network will handle not only conversational QSOs but will support many new services such as transfer of record messages, access to electronic data bases, transmission of videotex and facsimile images, and digitized speech. It has great potential not only for amateur-to-amateur communications but increasingly for disaster communications. Packet radio is not simply a high-tech replacement for radioteletype; it is a reliable and error-free method of transmitting any information that can be digitized. Packet radio is now a part of the Amateur Service.

#### A ROLE FOR NATIONAL SOCIETIES

National Societies can contribute to the development of packet radio. Societies can encourage creativity and identify resources needed to develop the network and its services within their countries. Domestic and international regulations should be examined as outlined in IARU Resolution 85-7.



Drafting of new regulations should be founded on the Amateur Service's long tradition of policing itself and a bond of trust between amateurs and their governments. Rules should not be overly specific, but rather should be broad enough to permit an orderly evolution of standards without necessitating frequent rules changes. It will take time and skill to strike a proper balance between the freedom for amateurs to innovate and the legitimate concerns of governments.

Because packet radio is expanding and making continual technical progress, there is a need for timely flow of information. ARRL Headquarters keeps fully informed about packet-radio activities in North America and elsewhere. Gateway, QST, QEX, the ARRL Handbook for the Radio Amateur and ARRL Amateur Radio Computer Networking Conferences are used regularly to disseminate information about packet radio. While we recognize that our English-language publications do not adequately serve the needs of Spanish-, Portuguese-, and French-speaking amateurs in the Western Hemisphere, we are willing to explore ways of overcoming the language barrier.

#### LOCAL AREA NETWORKS

Most packet-radio activity in the United States presently centers around 2-meter digipeaters (digital repeaters). Typically, these digipeaters serve an area within 50 km and are more often than not located near population centers. In addition to the digipeater, many local-area networks (LANs) have a computer-based message system (CBMS) (usually called a Packet Bulletin Board System [PBBS]) to store messages between amateurs in the LAN.

Increasingly, new LANs emerge, and those neighboring others wish to link. That can be accomplished by having the digipeaters in each LAN operate on the same frequency. A common frequency in the United States is 145.01 MHz. This linking arrangement is workable in the beginning when there are only a few stations in each LAN. As packet-radio populations grow, this method of linking leads to hopeless congestion, and alternative frequency plans are sought. The popularity of repeaters in the United States brought about the necessity for frequency coordinators for each area of the country. Many of these coordinators have designated a suite of 2-meter frequencies (typically 145.01, 145.03, 145.05, 145.07, and 145.09 MHz) for packet-radio. They rely on the packet-radio users themselves to sort out which frequencies are used for digipeating, bulletin boards and other applications. Cooperation at the local level is a prerequisite to successful development of LANs and inter-LAN linking.

It is anticipated that some Region 2 areas where there are concentrated amateur populations will follow the LAN/inter-LAN pattern similar to that outlined above. However, it is more likely that the geography and dispersed ham population will draw Latin American packeteers more toward HF. In these still early days in the growth of packet radio, HF may be the only way for an isolated packeteer to talk to another station on this new mode.



## HF PACKET OPERATION

Packet radio via HF is practical for virtually all distances worked by the more traditional modes of CW and SSB. There is a slight qualification in that the high data rates used are somewhat susceptible to multipath fading. This problem can be minimized by operating at or near the maximum usable frequency (MUF). The present convention on HF is 300 bauds, but operation at 1200 bauds is possible. With additional research and development, 1200-baud HF operation should be more reliable than present 300-baud packet. It would not be in our long-range interests to have international or domestic regulations codify our present HF packet-radio conventions, particularly 300-bauds at 170-Hz shift. It is desirable that amateurs be able to upgrade to higher speeds and different modulation techniques without having to petition for specific changes in the rules. There is much to be learned through on-the-air experimentation to improve the performance of HF packet radio and thus make a contribution to the state of the art.

## HF PACKET NETWORK DEVELOPMENT IN THE UNITED STATES

While VHF packet radio has been active in the United States for about five years, there has been serious HF operation only within the last two years. This activity was coincident with the emergence of PBBSS capable of automatic message forwarding.

Today, there are approximately 35 operational HF packet-radio stations with an automatic message-transfer function. They are located in or near 50% of the metropolitan areas of the United States and act as gateways between HF and their VHF LANs. The other 50% of the densely populated areas are served by VHF only.

At present, the effectiveness of this HF network is limited by problems. Probably the most serious problem is that virtually all stations operate on 14 MHz day and night, while a few operate on 7 MHz. Good coverage of the country requires use of frequencies in the 3.5, 7, 10 and 14-MHz bands, according to distance and time of day.

Existing Federal Communications Commission (FCC) rules require the presence of a control operator whenever HF stations are transmitting. If strictly observed, this means that an HF packet station capable of automatic operation must be closed down at all times when an operator is not at a control point. This means that the HF packet-radio operation is presently limited to times when people are at home (or perhaps at work if they have a control capability there). Among packet-radio operators there is a consensus that HF packet stations can be operated automatically on an unattended basis without undue interference to others and without malfunction. Before this can be permitted, there needs to be a demonstration of such unattended operation and general acceptance of the results on the part of other amateur users of these bands and FCC regulatory officials.



The ARRL Digital Committee is now in the process of conducting a survey of all HF gateway stations. The objective of this survey is to provide data on which to prepare a plan for the improvement of HF packet-radio relay operation. Changing frequencies according to propagation is to be part of the plan. Also, the survey data will be used for preparation of a request to the FCC for a Special Temporary Authority (STA) to conduct tests of unattended packet-radio operation on specific channels in the HF bands. Results of the tests under the STA are to be used by the ARRL in considering petitioning for future rule changes.

In addition to the STA, the ARRL Digital Committee is in the process of developing a model of an HF packet-radio relay network for the United States. Because of the need for simultaneous coverage of three frequencies, which typically cannot be provided by a single amateur station (for interference and economic reasons), a "cluster" concept has been proposed. The basic idea is that a cooperatively formed cluster consist of three HF packet-radio stations, each covering a different frequency. In addition to packet-radio stations, clusters could also include other stations to operate the more-conventional modes of voice and CW. Intercommunication between stations in the cluster would be by VHF, either packet or voice. In its present stage of development, the model suggests having seven clusters within the continental United States. It would follow that additional clusters would be needed in Alaska, Hawaii and Puerto Rico in the future.

## HF NETWORK DEVELOPMENT THROUGHOUT REGION 2

Canada has a number of isolated VHF LANs but only limited use of HF packet radio to date. It can be anticipated that Canada will develop an extensive VHF network for its populous southern border and that HF will play some part in reaching northern remote areas. One can also expect numerous VHF links between Canada and the United States along the long common border.

The geography and Amateur Radio population distribution within Latin America indicates the need for extensive reliance on HF for packet radio. HF propagation over the north-south path between North America and Latin America is generally good, and offers excellent possibilities for both normal amateur-to-amateur communication and for handling disaster traffic.

An effective HF packet-radio relay system throughout Region 2 could greatly improve handling of messages in connection with future disasters of the magnitude of the recent Mexico earthquake or the Columbian volcano eruption. With automatic operation of packet relay stations providing around-the-clock coverage, it would be possible for stations in disaster situations to send a situation report and to initiate requests for direct point-to-point links to be established. These may be either by packet for record traffic or SSB for communications best handled by voice. As in the cluster concept, VHF could be used for coordination of the different stations at the scene of action.



It would seem reasonable that HF packet relay stations be located in countries with favorable domestic rules and international agreements. Such is the case for nearly every country in Region 2. Appendix A is a map showing countries that permit amateurs to communicate with the United States on behalf of third parties.

Appendix B is a world map showing examples of where major HF relay stations might be located, with consideration given to regulations and reasonable HF path lengths where possible. This map is offered only as a think piece to generate discussion. It stands to reason that each National Society will want to look first at its domestic requirements and then to its neighbors. A fairly structured HF network may be the optimal choice for certain areas, and an informal, possibly laissez-faire, approach indicated in others.

#### AMATEUR SATELLITES AND METEOR SCATTER FOR PACKET RELAY

Earlier types of amateur-satellite systems were not ideal for packet radio. The combination of their error performance and availability suitable only for experimentation, not regular packet-radio relay. Over the past five years, however, amateur-satellite and packet-radio developers have been in close contact, and are including packet-radio features into new satellite systems. Two types of orbit appear to hold promise for packet radio: (a) the low-earth orbit for store-and-forward coverage of virtually the entire globe, and (b) the geosynchronous orbit, such as planned for AMSAT Phase 4 satellites, for real-time relay to all points on one-third of the earth from one satellite and the whole earth with intersatellite relay. We salute the work done by the JARL/JAMSAT/NEC/NASDA team and their successful launching of Fuji OSCAR 12 (FO-12) on August 12, 1986.

Meteor scatter (MS) has been known to amateurs since the late 1930s. To date, it has been more of an experimental mode than one used for routine communications. European amateurs have demonstrated how high-speed-CW burst transmissions can be used via the MS propagation mode, which occurs in bursts on the order of 250 milliseconds. Packet radio protocols can be tailored for an ideal match with MS propagational characteristics. Amateur MS packet radio is still in its infancy. Two amateurs, W3OTC and WØRPK, made history on August 5, 1984 by exchanging packets at via 6-meter packet radio. They concluded that the packets transmitted at 1200 bauds were too long to exchange a packet and an acknowledgement during most MS bursts. While operational commercial MS networks use 4800 bauds (limited by the bandwidth of channel allocations), amateur thinking favors 9600 bauds for MS. Tests at this speed have awaited suitable modems, which are expected to become available during the next year.

#### CONCLUSION

Packet radio is becoming a key resource for the Americas, for both amateur-to-amateur and disaster communications.



HF offers an immediate way of interconnecting geographically separated local-area VHF/UHF networks. A global HF packet-radio network is now emerging. Further technical development is needed to bring the reliability of HF packet radio closer to the theoretical possibilities.

The recently launched FO-12 satellite has great potential for worldwide packet relay. Ground-station operators need to obtain compatible equipment and to find ways of interfacing the new FO-12 capabilities with existing packet-radio operations. Additional developmental work is needed on future low-earth-orbit and geostationary satellites for packet-radio relay.

Meteor scatter should become important for long-distance packet-radio relay in the years ahead. Modem and protocol development work remain to be completed.

In a relatively few years, the Amateur Service should have not only VHF/UHF packet-radio local-area networks but three long-distance packet modes of HF, MS and satellites. Each has different characteristics and deserves development to their maximum potentials. The combination will give us a robust worldwide network capable of communicating under virtually all conditions.

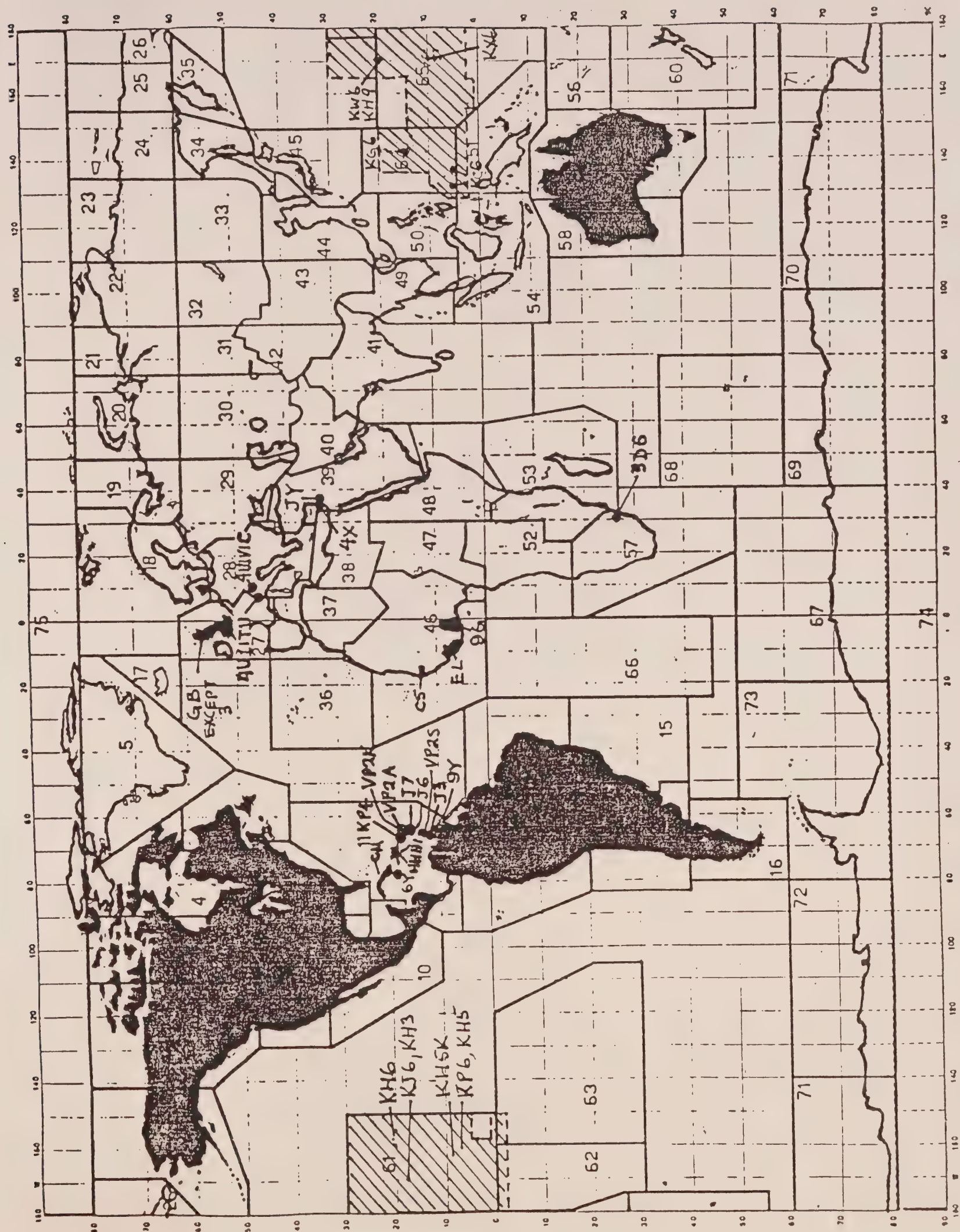
Paul L. Rinaldo, W4RI  
Chairman, ARRL Ad Hoc Committee on  
Amateur Radio Digital Communication

August 20, 1986

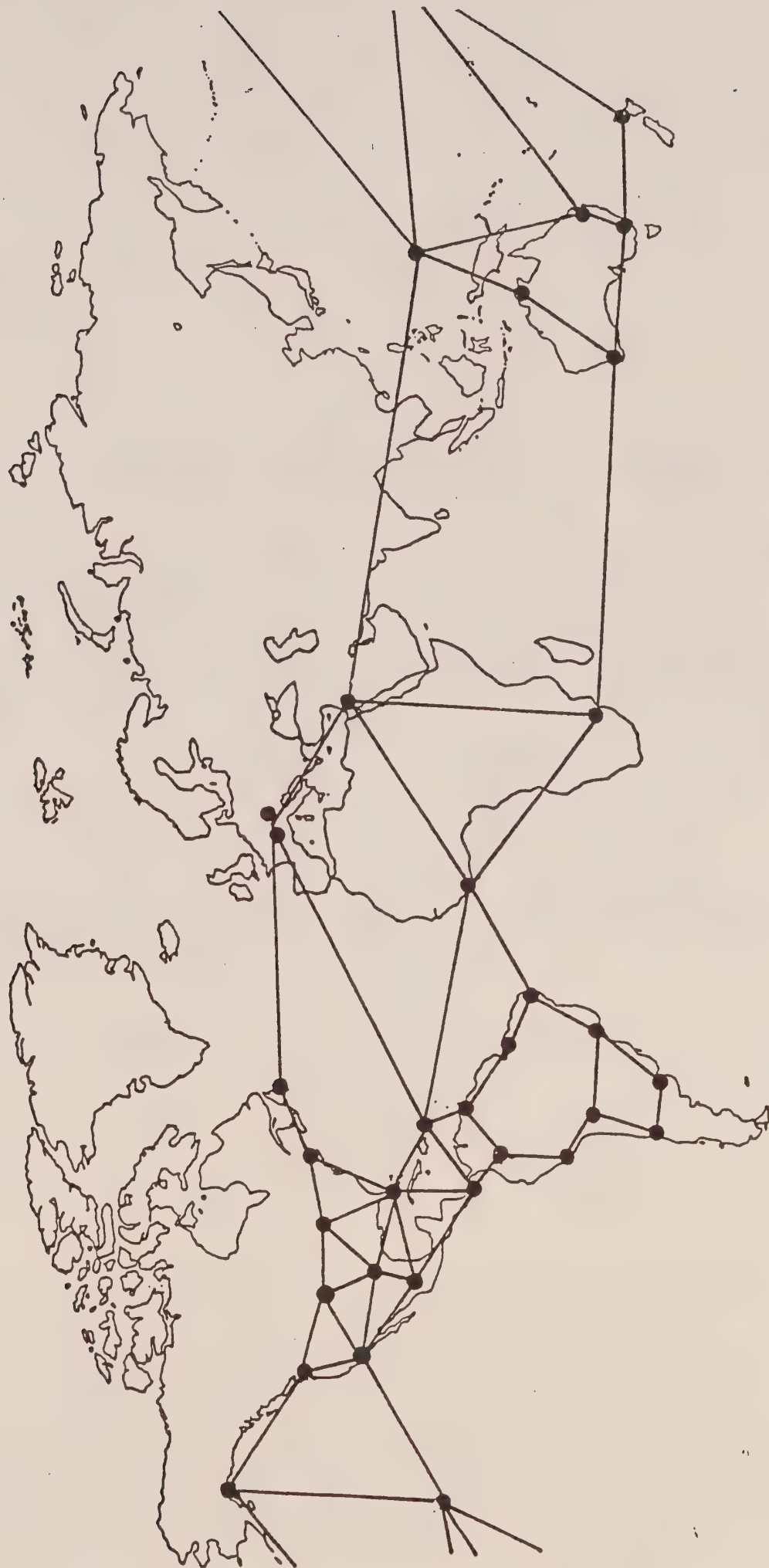
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December 22, 1986

M. L. Gibson, W7JIE  
1215 N 28 Place  
Renton, WA 98056

Dear Gib:

This is in response to your speed letter, your recent telephone calls and that of Clay Freinwald, K7CR, asking what frequencies digipeaters can operate on according to Part 97.

My understanding of the problem is that Western Washington Amateur Relay Association (WWARA) wants to use frequencies in the 145-146 MHz range for digipeaters. More specifically, they are experiencing congestion using simplex digipeaters on 145.01-145.09 and feel that duplex-frequency operation would reduce contention. WWARA is considering the following pairing:

145.01	145.61
145.03	145.63
145.05	145.65
145.07	145.67
145.09	145.69

Further, this proposal would apply not only to the states of Idaho, Montana, Oregon, and Washington, but to the province of British Columbia as well.

The first consideration is what does Part 97 of the FCC rules provide? That is not simply answered. It is confused by some because of the word "digipeater" is an obvious contraction of "digital repeater." One may be led by this to conclude that a digipeater is a repeater in the sense intended by Part 97. If one has followed the evolution of Part 97, what we now term a digipeater was not thought of when the repeater rules were written.

The concept of "packet switching" was introduced into the rules in section 97.69 as a result of Docket 20777 which permitted ASCII. Several conversations with FCC officials responsible for handling Docket 20777 indicated that they thought that the language in section 97.69 resulting from Docket 20777 authorized packet radio in the Amateur Radio Service. It is fair to conclude that the FCC officials expected amateurs to take it from there. Nevertheless, nagging doubts as to the legality of packet radio have cropped up from time to time. The words in section 97.69 do not seem convincing enough for some.



So, I believe we can rest assured that the FCC intended packet-radio operation to be authorized. Unfortunately, neither the FCC or the Amateur Radio community in 1980 when Docket 20777 was being considered knew enough about this new mode to get the right words into the rules. In fact, subsequent to Docket 20777, there were several changes in the rules to fix technical inconsistencies. Some remain, and should be remedied as we and the FCC gain experience. It does not mean that everyone who discovers what he/she thinks is a glitch in the rules should panic. There is an orderly process through which we must go to petition for rule changes. Normally, it does not advance the understanding of apparent inconsistencies in the rules to ask FCC staff their interpretation. If the rules are inconsistent, people will interpret them differently. Also, you run the risk of being given an answer you didn't want by asking someone who did not have all the background and the inquisitor's context clearly in mind.

Nevertheless, given the rules as written, we need to continue to operate until they can be improved. In this instance, we need to determine whether it is permissible to operate a duplex-frequency digipeater in the frequency range proposed by WWARA.

If one's interpretation of Part 97 is that a digipeater is a repeater, then it would follow that digipeaters would be permitted to use only repeater subbands specified in 97.85(h). That paragraph excepts the range 144.0-144.5 and 145.5-146.0 for repeater operation. Also, those who advocate this interpretation would then go on to accept the following paragraph of the rules as requiring that digipeaters send "/R" at the end of digipeater call signs:

"97.84 Station Identification

\* \* \* \*

"(d) When an amateur radio station is in repeater, auxiliary or beacon operation, the following additional requirements shall apply:

"(1) When identifying by radiotelephony, a station in repeater operation shall transmit the word "repeater" at the end of the station call sign. When identifying by radiotelegraphy, a station in repeater operation shall transmit the fraction bar  $\overline{DN}$  followed by the letters "RPT" or "R" at the end of the station call sign."

The above wording contains a technical flaw. While the term "telegraphy" is used, the appearance of  $\overline{DN}$  makes it clear that the intent here is to specify how an identification is sent in Morse code.  $\overline{DN}$  is peculiar to Morse code and is not germane to



other forms of radiotelegraphy. It could have been worded "the fraction bar ( $\overline{DN}$  when international Morse is used)" to indicate that all forms of radiotelegraphy are intended. Nevertheless, it is reasonable to assume that the FCC rule drafter meant to have radioteletype repeaters identify with a "/RPT" or "/R" suffix to their call signs.

That doesn't necessarily apply to packet radio, even if digipeaters are considered to be repeaters at least for identification purposes. Recall that it says "radiotelegraphy." Telegraphy is defined by ITU Radio Regulations as:

"A form of telecommunication which is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such a form. For the purposes of the Radio Regulations, unless otherwise specified therein, telegraphy shall mean a form of telecommunication for the transmission of written matter by the use of a signal code."

Radiotelegraphy covers radio communication by international Morse code and radioteletype. It also includes facsimile. Again quoting the Radio Regulations:

"Facsimile: A form of telegraphy for the transmission of fixed images, with or without half-tones, with a view to their reproduction in permanent form."

That nails down how repeater IDs should be handled, according to the letter of Part 97, for international Morse code, radioteletype and facsimile.

Radioteletype is intended to transmit "written or printed matter" and thus fits the definition. In ITU parlance, radioteletype is "narrow-band direct-printing telegraphy. Packet radio does not fit this definition. Packet fits a different category. For emission designation purposes, "Telegraphy -- for automatic reception" (third symbol B) is appropriate for RTTY, but "Data transmission, telemetry, telecommand" (third symbol D) fits packet. Packet is computer-to-computer communication of a wide variety of data which may never be printed on a page, and even then only after the fact at the end point.

However, if you probe Part 97 further, you will find that "telemetry" is defined in paragraph 97.403(d) as:

"Space-to-earth transmissions, by a station in space operation of the results of measurements made in the station, including those relating to the function of the station."



"Telecommand operation" is defined in paragraph 97.403(c) as:

"Earth-to-space Amateur Radio communication to initiate, modify, or terminate functions of a station in space operation."

This would lead you to believe that telemetry and telecommand is limited to space operation. But then, section 97.69 says:

"Subject to the special conditions contained in paragraphs (a), (b) and (c) below, an amateur radio communication may include digital codes which represent alphanumeric characters, analogue measurements or other information. These digital codes may be used for such communications as (but not limited to) radio teleprinter, voice, facsimile, television, communications to control amateur radio stations, models and other objects..."

In other words, digital codes are permissible for transmission of telemetry and telecommand in terrestrial Amateur Radio so long as you don't call them that, because those words are reserved for space communication, according to part 97, Subpart H. "Broadcasting" is another thing that is permissible under the rules so long as you don't call it that; i.e., we can transmit bulletins addressed to All Radio Amateurs and code practice to hams and would-be hams but would be out of step with Part 97 if they call these things broadcasting.

From the foregoing, it may be concluded that the rules contain inconsistencies, probably caused by not picking up on the subtle changes needed to reflect the full impact of new modes, such as packet radio, that the FCC intended to authorize by certain rule changes.

There is doubt that section 97.84 contains ID rules that are implementable on packet. On the other hand, the Memorandum Opinion and Order in PR Docket No. 85-105 adopted October 6, 1986, changed section 97.80 of the rules to read:

"No amateur station may be operated under automatic control while transmitting third-party traffic, except an amateur station retransmitting digital packet radio communications on frequencies 50 MHz and above. Such stations must be using the American Radio Relay League, Inc. AX.25 Amateur Packet-Radio Link-Layer Protocol, Version 2.0, October 1984 (or compatible)."

Thus AX.25 Version 2.0 was written into the rules, and its published protocol definition document specifies how digipeaters will identify. It is not practical to comply with section 97.80 when transmitting third-party traffic and 97.84 when not.



Before leaving the subject of AX.25 IDs, there is the apparent assumption of WYSIWYG (what you see is what you get) when you mention identifying as "W7JIE-3." In fact, that ASCII characters W7JIE are sent and are followed by a bit pattern that is specified in AX.25 as the SSID (secondary station identifier). In case anyone missed this point, AX.25 is a bit-oriented protocol not a character-oriented protocol. In bit-oriented protocols, the function of a particular bit is determined by its location, and the meaning of the bit is carried by its state -- 0 or 1. (Character-oriented protocols were already out of, and bit-oriented protocols in, favor in the telecommunications industry when the FCC first permitted ASCII.) As in CCITT X.25, the AX.25 frame is laid out in integral octets. While the SSID-peculiar bit pattern is actually what goes out on the air, the "-3" is what is displayed to the operator as part of the command-response syntax of the minimal presentation layer written into the TNC code. Thus, "-3," as such, is never sent on the air. Because the actual transmitted bits are never displayed as such but must be converted to something displayable by the TNC program, it is possible to replace the TNC program with one that displays "/R" after each repeater call sign if it would make everyone feel better. Nevertheless, this has nothing whatsoever to do with the actual transmission and frame architecture as specified in AX.25. Such things are not link-layer functions but belong to the presentation-layer, for which there is no de jure standard. [The de facto standard is the TAPR TNC 2 command-response syntax. The Digital Committee is working on variants of CCITT X.3, X.28 and X.29 toward this end, but that's probably a year away.]

Having cleared up the digipeater ID question, there remains the question as to whether a digipeater must follow the repeater rules and operate only on the repeater subbands. Again, one must refer to the proceedings of PR Docket No. 85-105, which permits automatic control of packet stations on any frequency above 50 MHz. Digipeaters fit this definition. Accordingly, to say that digipeaters must stay within the repeater subbands would be to erase what amateurs fought for and won in PR Docket No. 85-105.

The only logical conclusion is that a "digipeater" is not a "repeater" in the Part 97 sense of the word. While both could be called "relay stations," close examination of the two indicate some fundamental differences. Repeaters usually use two frequencies; digipeaters usually use one. Repeaters retransmit exactly what they receive, normally in real time. Digipeaters modify the frame by setting a repeater address bit, perform error checking, acknowledge correctly received frames, etc., and do not relay in real time. Thus, a digipeater is a more intelligent relay station than a repeater. In ISO and CCITT terms, a repeater operates at the physical layer, while a digipeater functions at the data-link layer.



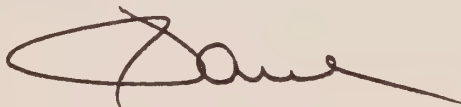
Although paragraph 97.69(d) says that automatic control is permissible when operating above 50 MHz, it would be reasonable to interpret this as meaning those frequencies on which data transmission is permitted. Because paragraph 97.61(a) does not have any valid emission designators for data transmission (--D), one must assume that telegraphy--automatic reception (--B), though technically incorrect, must guide. This boils down to staying out of 50.0-50.1 and 144.0-144.1 MHz. Also, one should avoid satellite subbands for terrestrial communication.

A digipeater may have the same liability as repeaters in the event of harmful interference if digipeaters are coordinated or share frequencies with coordinated repeaters. That is, if there is interference between a coordinated use and one that is not coordinated, the noncoordinated one has primary responsibility to resolve the interference.

I believe that the foregoing answers the questions posed to me on the telephone as to what is permissible and what is not. This, of course, is not a legal opinion.

This still leaves open whether or not the pairing contemplated by WWARA is the optimal solution to frequency congestion. This is a complex problem that deserves a bit more research and, ultimately, wider coordination. I'll try to pull together what I can in the weeks ahead and let you know. Meanwhile, it would be helpful to have from you the working band plan against which WWARA coordinates uses.

73,



Paul L. Rinaldo, W4RI  
Chairman, ARRL Ad Hoc Committee on  
Amateur Radio Digital Communication

cc: K7CR  
Counsel Imlay



Enclosure H

Dec 11, 1986  
Don Simon, NI6A  
Assistant Director  
Pacific Division,  
El Cerrito, Ca  
94530

RECEIVED  
ARRL 12-11-86

1986 DEC 13 AM 11:04

Paul Rinaldo, W4RI  
Editor QST  
Chairman, Ad Hoc Digital Comm. Committee

Dear Paul;

Enclosed is a file that is going about in WestNet. I really don't care what designators are chosen (or whose) but that we agree on some. Since this has got to be a national effort and that we all have to agree; and furthermore since the ARRL is the sponsor of NTS and a supporter of packet I urge the following;

Please have the ARRL fearlessly create the dialogue (notice I didn't say dictate) and coordinate the data base that is needed. This can be accomplished by stating the problem and asking for input from all across the Country in "Gateway", "QST", and "ARRL Forum". Please feel free to use the enclosed or extracts thereof if you are short on material.

Thanks for your support!

73.



Donald Simon



(Sysops please keep a copy of this in your files for NTS user interface as  
ntsbbs.dec)

## WESTNET NTS/PACKET OPERATION SUGGESTIONS

After extensive dialogue with WestNet Section Traffic managers  
and BBS sysops the following NTS guidelines are being suggested  
for WestNet NTS/PACKET operations.

### Unbundle Your Messages Please

1. One NTS message per BBS message. Please remember that traffic eventually  
will have to be broken down to the individual addressee somewhere down the  
line for ultimate delivery. When the originator places two or more NTS  
messages destined for different addresses within one packet message,  
eventually the routing will require the message to be broken up by either the  
bbs sysop or the relay station; placing an additional unreasonable burden  
being on them both. Therefore it is suggested good practice for the originator  
to expend the extra word processing in the first place and create individual  
messages per city regardless if there are common parts with other messages.  
This means that book messages are not suitable in packet at this time unless  
they are going to the same city and that messages should be sent unbundled.

### Designators

2. There is a need to agree on common NTS designators to be used for automatic  
forwarding on packet BBS. On Saturday November 29th, three Section Traffic  
Managers, the Pacific Division Director, and the Net Managers of The Northern  
California Net, Northern California Net VHF, and the NCN packet manager agreed



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that this was an essential goal; for NTS to be able to interface with packet on a national level, suchly. The designator must be recognized at each node and cause a minimum of human intervention. The data base for forwarding should not be too large.

A: Designators by AFRL "section", "grid square", "zip-code", etc, were discussed and rejected for the following reasons:

The correct section abbreviations are not well known.  
The exact section location of a given town in California, New York, New Jersey, Florida, etc, is almost impossible to identify without exact county border maps which would make virtual routings very difficult. The data base is large.  
The "break-up" in a state like California with 9 sections is cumbersome.

For similar reasons we rejected using grid squares, area codes, and zip codes as all would be too numerous to support and place too great a burden on both originator and sysop in terms of both quantity and availability. It is expected that in a few years suitable software and hardware will be made readily available to handle a more virtual routing scheme requiring even less sysop and user intervention.

A well known WestNet sysop and nationally respected packet tnc code developer is quoted:

"I agree, this a real mess. Until there is some software to pick apart the messages and break them into sections, I cant see a scheme where a sysop is required to do that manually, or even one where he must change the TO field based on an



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eyeball scan as being viable. Not all the sysops in the path will want to put out that much manual effort into things. Unfortunately, until we get to the next level of automation, those interested in NTS will have to do the work."

#### State/Province Abbreviations Best Interim Choice

B: Consensus agreement recommended using State, Province, and U.S. Possession abbreviations as spelled out in the U.S. Post Office and the ARRL Net Directory. Since one always knows at least the State that the traffic is going to; and since the correct abbreviation spelling is readily available; and since these designators are less than 70, they appeared to have decided advantage over other systems such as section, or region, or grid square designators which would require more sysop intervention and/or more difficult user interface.

#### National Forum Needed to Optimize Designators

C: It was agreed that a national forum was needed to be produced in a national magazine such as "Gateway" and "The ARRL Forum" Newsletters so that both NTS operators and packet people could agree on optimizing such designators in an open forum environment as well as to solve future problems. The forum's purpose would be to recognise problems at all levels; and to optimise and troubleshoot effective solutions by receiving input from all regions of the nation and from both packet and traffic people.

A quote from a well-known national packet MailBox designer;



4

" NTS has been very slow to adopt computers, much less advanced techniques. Will not be a big surprise if it takes them another 2-3 years to make good use of packet." And again from the same source; "What I hope will happen is that NTS will decide to make use of the packet store and forward system. To do this, SOMEONE has to take the lead and ask ALL the BBS sysops to adopt a uniform NTS routing format. The designators in EastNet were designed to aid the NTS folks, but were not invented by them. My problem is two-fold:

- 1) I want to help out.
- 2) I am not part of NTS.

Unless the NTS tells me what to do, I can't do much."

#### National Data Base of NTS/BBS Liaison

D: It was agreed that we would ask the ARRL HQ staff to maintain a national database of those packet BBS that can provide NTS liaison at a state/province, section, and/or region level. This will help BBS sysops tremendously in knowing whether or not certain NTS designators are able to travel via packet to their local or section nets and/if such liaison on packet has been established yet. A list of all BBS that provide NTS liaison and to what states should be regularly published and updated in both the aforementioned publications and that input should be solicited on a national basis. Since the ARRL is the sponsor of NTS and also a supporter of packet development; we thought that it would be the best national organization to do this important job.

With a national data base providing callsigns of mailboxes that provide specific state/section and/or region NTS interface; sysops



(particularly on hf) will be better able to route NTS traffic.

In other words, we cannot send traffic via the hf packet networks unless we know that there exists NTS interface on the other end. Without compatible designators, sysops have to constantly rearrange their forwarding tables or edit NTS messages constantly, or worse. We believe that with a little national coordination, things may move alot more efficiently.

#### NTS Packet Message Format to Remain the Same

3. There was consensus agreement that the packet format of NTS traffic was best left to be identical as if sent over CW, thus allowing easy compatibility to both CW and RTTY files should the individual messages need to be transferred from one mode to the other without requiring major word processing.

#### Packet Deemed Most Effective as a National Relay System

4. Packet was recognized as having decided advantages over existing circuits in regards to RELAYING NTS traffic due to its automatic time diversity abilities, the error free abilities, and the ability to obviate many propagation problems that frequently occur on hf long haul TCC schedules. High volume packet traffic service for special events and disasters would allow for here-to-fore unparalleled performance.

However, packet is not the panacea for delivery. So far there has been no dramatic increase in public service orientated NTS delivery stations with the



advent of packet; nor do we expect any great increase (but of course would welcome it). Conceptionally then, we envision packet to be ever increasingly important as an error free national RELAY means for NTS traffic, and there to liaison with existing section and local NTS nets through various liaison stations at certain designated mailboxes in order to bring the relayed traffic to the section and local nets for delivery and also to bring traffic from the section net and local nets to the packet linked bbs. We expect that the delivery ranges could be eventually increased via packet linked vhf mailboxes through the more effective linking of local and section nets on vhf through vhf linked packet mailboxes.

The conceptual model therefore was that packet would provide the national relay system that was needed to link each section and local net with each other. NTS, so to speak, would ride the coat-tails of Packet networking. Section nets would remain intact as the major origination and delivery mechanism of the system very much as it does today. Each section and/or local net would provide liaison with the linked packet automatic mail forwarding system through assigned liaison stations. It remains to be proven that packet will in itself be a factor in recruiting more hams into public service or NTS work per se, although preliminary observations have shown that there is a yet untapped resource of potential traffic handlers unable to check into the 80 Meter cw section nets and out of range of the 2 meter voice section nets, who suddenly find themselves "connected". Further work on delivery methods is a separate subject and cannot be covered here in detail.

#### List of Valid Designators

(sysops please include in your forwarding tables toward the appropriate mailboxes)



The following are the recommended abbreviations for nts traffic:

(Please note that it was felt that there was no need to put the letters nts in front of the state abbreviation although it should be noted that certain New England mailboxes support the format NTSXXX, where XXX is the ARRL section. Examples are NTSCT, NTSNH, NTSWMA, NTSEMA, NTSME, NTSVT, etc.

The following are the new recommended designators with their definition in parenthesis as determined by the November 29th meeting:

(Note that these are the standard Post Office abbreviations found in the ARRL Net Directory)

ak (alaska), al (alabama), ab (alberta), az (arizona), ar (arkansas),  
 bc (british columbia), ca (california), co (colorado), ct (connecticut),  
 de (delaware), dc (district of columbia), fl (florida), ga (georgia),  
 gu (guam), hi (hawaii), id (idaho), il (illinois), in (indiana),  
 ia (iowa), ks (kansas), ky (kentucky), lb (labrador), la (louisiana),  
 me (maine), mb (manitoba), md (maryland), ma (massachusetts), mi (michigan),  
 mn (minnesota), ms (mississippi), mo (missouri), mt (montana), ne (nebraska),  
 nv (nevada), nb (new brunswick), nh (new hampshire), nj (new jersey),  
 nm (new mexico), ny (new york), nf (newfoundland), nc (north carolina),  
 nd (north dakota), ns (nova scotia), oh (ohio), ok (oklahoma), on (ontario),  
 or (oregon), pa (pennsylvania), pe (prince edward island), pr (puerto rico),  
 pq (province quebec), ri (rhode island), sk (saskatchewan), sc (south  
 carolina), sd (south dakota), tn (tennessee), tx (texas), ut (utah), vt  
 (vermont), va (virginia), vi (virgin islands), wa (washington), wv (west  
 virginia), wi (wisconsin), wy (wyoming), aposf (apo/fpo san francisco),  
 aposea (apo/fpo seattle), apony (apo/fpo new york), apomia (apo/fpo miami),

In addition all foreign (except Canada/US traffic) NTS traffic routed to



countries in which there are third party traffic agreements should not be relayed via the packet system at this time until proper routing designators and procedures are established. Such traffic may be sent via the pre-existing NTS CW and SSB nets and are normally designated to go to the Eastern Area Net (EAN).

California Designators

Within California there should be additional designators as well that permit automatic fwding more efficient for our particular application. In addition to the post office state/province designators, the WestNet BBS should support the following designators:

- scn (southern california net - sent toward w6ixu)
- scnsb (southern california net - sent toward w6ixu)
- scnsd (southern california net - sent toward wb6kqy)
- ncn (northern california net - sent toward w6cus)
- ncnsac (northern california net sacramento valley - sent toward wd6bfc or wa6nwe)
- rn6 (sixth region net -sent toward w6cus)

Traffic should be listed as rn6 if there is no known packet outlet for this traffic. NTS operators on w6cus-1 will pick this traffic up and enter it on the regular nts traffic nets. Any traffic whose routings are not known may be sent to w6cus-1 for sorting.

in addition within California the designator cessac should be sent toward wa6nwe-1 bbs in Sacramento. This is the designator for the Office of Emergency Services RACES pick up.



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## WestNet Designators

In addition to the California designators other WestNet BBs may want to initiate special forwarding designators.

RedCrs is the designator for Western Operations Headquarters for the 13 western States located in Burlingame, Calif. Route RedCrs toward N6IIU-1 for pick up.

Nevada traffic (nv) should be sent toward wb7bni at this time. At this time southern nevada traffic is only serviced. Texas (tx) traffic should be sent toward wa5jxy-1. New Mexico (nm) should be sent toward ka5zec-1. Colorado (co) traffic can be sent toward ka0wcx-1. Utah (ut) traffic can be sent toward wa7uzo. Arizona (az) traffic can be sent toward wb7bni. At this point wd6bfc is not linked with an Oregon or Washington State bbs so all rn7 traffic should still be sent via the hf system toward wb7dch near Seattle until vhf linkage is established.

## OPERATIONS

NTS traffic must be entered on WORLI compatible forwarding systems with the "ST" command. Example "ST ca" <CR>

"QTC 1 San Francisco" <CR>

Remember to use the "T" in the "ST" command or your message will not be able to be killed with the "KT" command at the end point.

Traffic from outside of WestNet could be sent to any one of the many HF WestNet mailboxes which have nts liaison such as kr5s, w6cus, wb6kaj, wOrli,



kd6sq or n4chv and from there be edited as to where next within the California system it should be sent. It is recommended that each state have their own "clearinghouse nts/mailboxes". In California the California NTS traffic is broken down to be forwarded as NCN, NCNSAC, SCN, SCNSB, SCNSD, and within the state all such designators should be honored by the automatic forwarding BBS network.

To kill NTS traffic use the "KT" command followed by the message number. Do so only after you are sure you have a valid copy. This erases the message so it won't be delivered twice. On some systems it also services a message back to the originator that the message has been picked up and by whom and when.

To list NTS traffic on the WORLI BBS network simply type "LT".

#### WESTNET IN AND OUT

WESTNET traffic can now be handled to co, ut, az, nm, nv, tx, and ca on vhf. Messages sent to these designators will be fwded automatically to the appropriate mailboxes. Messages going outside of WestNet at this time should be forwarded by your sysop to his closest hf gateway bbs that can provide outlets to known nts bbs on hf. For traffic not covered by your hf gateway, please fwd to w6cus-1 and mark the traffic as rn6 traffic. This traffic will be picked up by region level nts operators and put into the existing hf regular NTS nets if a packet outlet is not available. Thus all packet bbs sysops should have not only all the above state, province, and possession designators in their forwarding files but also the "rn6" designator as well. Again it is not necessary to prefix the state or region with the initials "NTS".



some of the work NTS can accomplish in the interim if it can act as a unified intentional organization;

"NTS-interested folk must devise and distribute a FWD file to the intermediate point. This can all be done within NTS, and be limited to those areas that can deal with receiving NTS traffic. Each receiving area selects its own endpoint designators, and distributes them outward, along with a BBS to which they apply. The NTS types at the source point then have to look up the right endpoint through some list distributed by NTS, but that puts the work load solely on NTS-interested folk and not on some poor sysop in the middle. All the sysop in the middle has to do is get packages of FWD files and merge them with his."

An obvious next step is for NTS to form an intelligent effort to approach this situation. Time will show us if NTS is organizationally structured adequately to so function.

Without such a coordination and structure, STMs, Net Managers, BBS sysops, and interested NTS operators have had to act individually by writing letters and sending messages to try to coordinate this. An impossible job given the numbers of BBS nationwide and the number of NTS packet operators.

In the meanwhile, it makes sense for STMs and/or Net managers to assign NTS operators who have packet to ascertain the paths from their local and hf gateway MailBoxes, and have them contact these sysops to arrange forwarding and ascertain "valid" designators. These coordinators may be appointed as Packet Net Managers and can be responsible in coordinating both the vhf/uhf linkage amongst neighboring sections within their area as well as suitable long distance paths. These circuits can then be utilized when conventional circuits fail due to propagation, over-load, disaster, missed schedule or etc.



Conversely, NTS operators who are on packet and check into a nationally linked MailBox (WORLI type), should at least notify their STM and Section Net Manager of their capability and their sysop that they can take traffic off the BBS system and place into their section net.

A mechanism obviously needs to be developed wherein all sections are thus coordinated and identified. The reason that this has not been accomplished already indicates a further weakness in the organisational structure of the NTS which appears to lack an efficient communications system from section level NTS operations to the decision making process at present. Since the area staffs' responsibility is clearly defined as not including the section level, and since ARRL headquarter's staff are merely administrators and thus not able to make policy decisions; the Section Net Manager or Section Traffic Manager has no well established mechanism within NTS or ARRL structure today to be able to accomplish his/her task (section to section) except to communicate the problem to the section manager, who may or may not be knowledgeable about packet and/or NTS. From there the communication may or may not go to the ARRL Division Director who again, may or may not be intimately knowledgeable about packet or NTS operations and thus not capable of making the most efficient decision or taking adequate action.

The purpose of the above is an attempt to explain to all concerned the situation of the nts/packet interface to-date at least in WestNet as it appears to me as former STM, TOC operator, and region net assistant manager and currently Net Manager for Northern California Net/Packet and a packet HF/VHF gateway MailBox sysop for almost two years; with the intent to thus hopefully encourage the implemenation of efficient public service third party communications through packet radio especially in times of emergencies.



Paul Rinaldo, W4RI  
Chairman DCAC  
ARRL  
Newington, Ct

Jan 11, 1987  
El Cerrito, Cal.

Paul some quick comments as to your request regarding the STA for "SKIPNET".

- 1) Not that concerned about the name teleport except that we usually reserved that name to distinguish ordinary gateways from satellite gateways (teleports). No big deal otherthan trying to keep multiple terms (no matter how inexact) to a minimum.
- 2) On the W6CUS-1 and N6EEG-2 teleports, they will be managed by the digital committee and club station committee of the East Bay Amateur Radio Club (ARRL affiliated) and also the East Bay Packet Radio Association. Of course WORLI plans to manage his own system; but as a whole I am certain that "Frisco" will take its' direction from Hank.
- 3) Future correspondence to W6CUS-1 and N6EEG-2 is correct currently (Don Simon and Don Stiver). Both stations are part of the EBARC/EBPRA sponsorship and are well equipped. However if you wish to address one member for "FRISCO" as a whole; we agree that WORLI should be the one.
- 4) "FRISCO" is acceptable to us as a mnemonic.
- 5) At this time (given that none of are currently set up for automatic changing of frequencies (although our transceivers have the capability; it seems to me that W6CUS-1 can sit on 7093 24 hours a day. WORLI can cover a 20 Meter freq, as wellas N6EEG-2. N4CHV if he should join us can do 40 and 20 Meters. We hope that in the future W6CUS-1 can do the skylight function; n6eeg-2 do the Pacific function (Hawaii, Guam, Alaska, Australia, etc, and WORLI and N4CHV with their beam antennas do the 20 Meter and above teleporting. WE have not worked out details other than we are ready on 40 meters and 20 Meters at this time.
- 6) We will be linked locally through multiport systems on 223.58 which is a backbone frequency for BBS only in the Bay Area. W6CUS-1 and N6EEG-2 see each other directly and WORLI is only one digipeater away. N4CHV sees WORLI directly and is only one digipeater away from both W6CUS-1 and N6EEG-2.
- 7) We will connect to the other BBS of the LAN and WestNet as a whole via this 223.58 backbone as WestNet is linked via vhf currently including Ariz, Utah, New Mexico, Nevada, Texas, and all of California. The linking is on 223.58 and 145.09, 145.01 MHZ.
- 8).W6CUS-1 has been the NTS holding BBS for the Sixth region for many years and has been sorting NTS traffic as to Section Nets on a daily basis and also redistributing nationally bound traffic to the appropriate gateways (mostly through N4CHV). This function will continue through W6CUS-1 if it can get multiport, multiconnection systems going in time. If not, the job will be delegated to another Bay area BBS that will allow user connections such as W6PW-3 or N6IIU-1. WORLI may be able to do this when he gets multiconnect going better.

ARES inteface is accomplished very nicely at ther moment



via the existing BBS. Most of the SECs and ECs as well as the State DES, skywarn, and California Dept of Forestry, have packet systems tied into 5 or more mailboxes. Statewide designators are already supported in WestNet for State DES Hq (DESSAC) and the Western Operations Headquarters for the American Red Cross (RedCrs).

Hope that I answered most of the questions.

WORLI, N6EEG, and myself have talked this over a little bit and we would all like more redundancy as systems are bound to be down from time to time and band conditions sometimes near impossible. Also we have crowding problems from amateurs that commercial systems do not calculate in their statistics.

We think also that we should go with existing technology now and leave the system open for future technical progress changes. Automatic frequency control by changing bands not only adds a new level of complication and possible failure; but introduces a new level of cost. Most of us run different antennas on different bands and there are added problems of antenna tuning, etc that will add to the complexity and cost as well as cause a possible coordination problem as well. Higher speeds and different shifts are fine ideas and so are the automatic frequency ideas; but if we are to prove the idea of AUTOMATIC CONTROL below HF; N6EEG and I strongly believe that we should not burden or jeopardize that proof with unproven and unavailable and complicated technical experiments. These technical experiments may be able to be gradually worked into an existing system or maybe warrant a separate STA as they seem to prove a different (but not incompatible) concept.

You had mentioned something about routing designators, but I don't see anything about them in the draft. If a message is to go from a user to a BBS, then to a teleport, then received from another teleport and sent to a skylight station, and then sent from the skylight station to a BBS to be forwarded on VHF to its destination BBS, all automatically, I think we need to think about how this will work; especially in regard from teleport to skylight, and skylight to bbs. Notice I am talking about designators and this includes NTS and third party traffic; which after all is according to the introduction is the humanitarian primary purpose of the STA "to handle large volume of traffic during disasters".

A large problem that I have with the STA is that you say in section 2.5b2 (page 2.2) that "the STA will not include a request for operating these teleport-to-skylight positions under automatic control". The TELEPORT under operator control to work SKYLIGHT stations, must be allowed to operate under automatic control or in my opinion we have created an impossible situation as I know of no one here willing to stay home and watch a screen all day. Not only do I strongly suggest that the Teleport to skylight station be allowed to operate under automatic control; but also to allow the skylight station to also operate under automatic control for at least the traffic coming from the Teleport if not also for traffic coming from the VHF/UHF LAN as well. Of all my concerns for a workable system that puts realistic demands on the operators; this is my major concern, knowing that all of us have limited time. Also please see Section 5.1c "The STA is not intended to provide for automatic control of stations performing communications between skylights, teleports and skylights, nor between US teleports and those overseas. Maybe I'm missing



something but what is the objection of teleport to skylight automatic operation?

In the map and some lists I have seen you have the callsign of W6CUS-1 as WA6CUS-1. The correct callsign is indeed W6CUS-1.

Strongly suggest including skylight stations in the STA under automatic control and to ACTIVELY solicit more stations to participate if we really want any sort of reliability and a practical experiment.

In the Table 7.9 you suggest regional frequencies for communication from skylight to teleport. We have a problem here with 3634 as it seems very close to the IMN net which is the ARRL NTS section Net for Idaho and Montana. It is also very close to Northern Calif Net; which is the ARRL Section NTS Net for SJV, SCV, EBAY, SF, and Sacramento Valley Sections.

By the way N6EEG is club station committee chairman of the East Bay Amateur Radio Club and Board of Director member of the East Bay packet Radio Assn (EBPRA) as well as sysop of W6CUS-1. I am digital communications chairman of the EBARC, sysop of W6CUS-1 and also Borad member of EBPRA.

Sorry this was so long...I tried to keep it short but wanted to be as comprehensive. On the whole it looks like a swell job; and I thank you very much for all the work that you have put forth in helping to make this STA a reality. Very 73,

Don Simon, NI6A  
AMRAD, PPRS, TAPR, EBPRA, sysop of W6CUS-1  
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**FOR IMMEDIATE RELEASE**

January 19, 1987

## **CALL FOR PAPERS FOR THE ARRL PACKET-RADIO CONFERENCE**

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Papers are invited on Amateur Radio digital communication, in particular packet radio in the following subject areas: transmission technologies, networking, network expansion and development, applications, operations, message handling, international matters, spectrum management, and integration of data, voice and images.

- more -



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